INDIAN MUSICAL SCALES

Based on work done by the late Ustad Abdul Karim Khan and Pt. Balakrishnabuwa; annotated and modernised by the Sangita Prachar Mandal, Bombay

Introduction

The research on the Basis of Indian Music, is a formalisation and an extension of the principles rediscovered by Khansaheb Abdul Karim Khan, after life-long experimentation and discussion based on training in a musical family dating from the times of Raja Man Singh — the family of Dhondu Nayak. The Thesis as it stands now is thus the result of a concentrated effort of a total of at least sixty years with a background of about four hundred years. The Thesis has recently been checked by modern methods of measurement and reasoning, and has been given a new form that is more amenable for setting out on paper and thus more in tune with the times. This note outlines the Thesis in this modern version while leaving the content of the work unchanged.

The Problem

1. What were the ancient basic scales, and on what principles were the scales constructed?
2. How did the different modes — *jatis* and *ragas* — arise? What was the principle governing them?
3. Did these principles and rules undergo gradual transition in course of time, or was there a sudden break with traditional theory with the advent of Muslim rule? Did South India break away from the music of the rest of India, at any time, at least as regards its basis?

4. Thus, does present-day classical Indian music have any direct link with ancient music? If so, what is the dynamics of present-day music? What characterises a *raga* to-day? What is the place of rhythm in such music? What is the importance of the time of the day for a *raga?* What is the place of words in music?
5. Is any modification necessary in the various 'systems' of Indian music accepted by our many music schools of to-day? Is any modification necessary in the method of teaching or in the prevalent notation system?

Background

The oldest available text, in Sanskrit, dealing with the basis of Indian Music is the 28th Chapter of the *Natyashastra* of Bharata, written certainly not later than 300 to 600 A.D., though some place it centuries before Christ. (There is considerable doubt about the date of the *Naradi Shiksha*, so we do not refer to it; and certain other works such as those of Kohala, Tumburu etc. are extinct). Then comes the work of Dattila (ca. 500 A.D.), Matanga (not earlier than 500 and not later than 1200 A.D.), then the book of Sharangdeva (ca. 1200 A.D.) and Kallinatha's commentary on it (ca. 1400 A.D.). About 1550 A.D. or so we find the books of Ramamatya and Damodar. Round about 1600 A.D. comes a plethora of books — those of Pundarika Vitthala, Ahobala, Lochana, Somanatha, Bhavabhatta, Venkatamukhi, Shriniwasa, Raghunatha Bhupala and Hridayanarayana. In 1700 A.D. we have Shrikantha, and between 1750 and 1800 the compilations of Tulajiraje and Sawai Pratapsingh Rajee. In 1850, Surendramohan Thakur wrote his *History of Indian Music*, in English, from which many Westerners drew their data and conclusions.

On the supposition that none of these works lead to a consistent theory of Indian Music, Pandit Appa Tulsi (about 1900 A.D.) wrote five books, three of them in Sanskrit, in the make-believe that they were old works. Inspired by this approach Pandit Bhatkhande wrote two books in Sanskrit under the name of Chatur-Pandita; and four books (1912-1933) in Marathi under the name Vishnu Sharma, in which Chatur-Pandita was cited as authority for current music.

Clearly therefore, a rational solution to the problems should seek consonance with books written upto 1700 A.D. only.

The first systematic attempt at finding out the basis of scale-building, with the help of ancient texts, was made by Messrs. E. Clements I.C.S. and Rao-Bahadur R. G. Deval towards the close of the last century. They took the help of various musicians among whom they found Abdul Karim Khan the most suitable. This attempt died out, chiefly because the Khan could not agree to the scales derived as musically 'correct'. This attempt, however, gave impetus to others, among whom may be mentioned Achrekar, Telang, Mulay, Paranjpe, Feroz Framji, and Mehta. Their work is more or less on the same lines as those of Clements and Deval. Appa Tulsi gave this own derivation, which is cited by Bhatkhande. Bhatkhande had his own opinion or sets of opinions. Recently Prof. Swarup, Pt. Omkarnath, Pt. Brihaspati and others have produced their own systems, which again are more or less a re-arrangement of the Clements-Deval Structure. Thus there are perhaps as many interpretations as there are theoreticians; however, experimentation and demonstration is lacking. The only workers who are on record as having made experiments are Clements, Deval and Achrekar.

The Thesis

Abdul Karim Khan, parting company with Clements and Deval, worked on his own, and evolved his principles by experiments alone. Kapileshwari amplified and formally presented them in the context of old texts, and got them checked by modern methods.

We will now state this Thesis, show where why and how it differs from the work of the writers mentioned above, and try to draw comparative conclusions. The main passages from old texts, with which any new interpretation must tally, cover the following ground, so far as scales are concerned:

Octaves (*saptakas*) are in ascending order, each octave being 'double' of its lower one. Three octaves are in common use. Strings are the best means to explore scales. Within each octave there are seven notes (*swaras*) in ascending order, the *shadja* (*Sa*), *Rishabha* (*Re*), *Gandhara* (*Ga*), *Madhyama* (*Ma*), *Panchama* (*Pa*), *Dhaivata* (*Dha*) and *Nishada* (*Ni*). Each octave comprises of 22 *shrutis* — a *shruti* may be a transient note, the imperceptible form of a *swara* (note), or a device to measure intervals between notes. As a matter of fact *shrutis* are innumerable, but 22 is the convenient chosen number. Intervals between *shrutis* are called *antah-shrutis*, (inner intervals), and they are very small (*keshagrava*= hair breadth). The intervals *Sa* to *Pa* measures 13 *shrutis*, and the interval *Sa* to *Ma* 9 *shrutis*. Notes which have an interval of 9 or 13 *shrutis* are called *samvadi* (consonant), notes with an interval of 20 *shrutis* — or by inversion 2 — are *vivadi* (dissonant); the rest are *anuvadi.* (Bharata). Or, notes separated by 8 or 12 *shrutis* are *samvadi*, notes separated by 1 *shruti* are *vivadi* (Sharangdeva). *Sa* has 4 *shrutis*, *Re* 3, *Ga* 2, *Ma* 4, *Pa* 4, *Dha* 3 and *Ni* 2; these are the pure (*shuddha*) notes. This makes for a systematic organization of notes called a *grama* (town), and the above organisation is the *shadja-grama* i.e. a *grama* on the tonic *Sa*. The other organisation is the *madhyama-grama*, which differs from this only in having its *Pa* one *shruti* lower; this lower *Pa* is called *madhyama —gramapanchama* (*madh-pa* or *ma g -pa*). A third *grama* called *gandhara grama* is also there but is obscure. *Ga* may be raised by two *shrutis* to make it "*Dha*-like", or *Dha* may be lowered by two *shrutis* to make it "*Ga*-like". Such displacement can be made for all notes and results in 4-*shruti*-intervals in a well-ordered way. Such a process is called *Swara-Sadharana*, and yields notes which are neither the original *shuddha* note nor the next *shuddha* note; the notes must however be given the name of the original note and not the next note. The displacement process is very fine and therefore is called *kaishiki.* The displaced *gandhara* is called *antara ga*, the displaced *nishada* is called *kakali ni; kakali* means resulting from effort or being very fine.

A demonstration of the 22 *shrutis* for the two *gramas* may be had by having two identical *vinas* tuned according to the *shadjagrama.* Keep one aside as the standard (immoveable). Convert the second to *madhyama gramma* by lowering its *Pa*, the lowering is one standard *shruti.* Arrange the *shadjagrama* on this *vina* taking this lowered *Pa* as referant; there is a shift of one *shruti.* Repeat the process and you will find that the *Ga* and *Ni* of the standard (first) *vina* enter (i.e., are in unison with) the *Re* and *Dha* of this second *vina* being higher by 2 *shrutis.* Repeating once again, the *Dha* and *Re* of the second *vina* enter the *Sa* and *Pa* of the first, being higher by 3 *shrutis.* A fourth repetition makes the

Ma, *Pa* and *Sa* of the second *vina* face the *Ga*, *Ma* and *Ni* of the first *vina*. (Bharata).

Or, take two identical *vinas* with 22 strings each, and let their strings emit notes successively higher, the higher and higher sounds being according to the *shrutis*. Let *Sa* be on the 4th wire, *Re*, 3 units from it, *Ga* 5 units, *Ma* 9 units, *Pa* 13 units, *Dha* 16 units, *Ni* 18 units. (The working can also mean *Re* on the 7th wire, *Ga* on the 9th, *Ma* on the 13th, etc. The language used is not clear-cut.) Displace the notes of the second *vina* so that each note is emitted by the previous wire. The rest of the description of the process is the same as above — (Sharangdeva).

This is the minimum common basic structure on which any interpretation must rest. Certain salient points must here be stressed in the light of what follows:—

Vadi & Samvadi: Bharata clearly mentions that notes with an interval of 13 or 9 *shrutis*, such as *Sa* on the 0 (starting) *shruti* and *Pa* on the 13th, and *Sa* on the 0 and *Ma* on the 9th, are *samvadi* or consonant. (Some take *Sa* on the 1st *shruti*; this hardly matters if the whole gamut is shifted by 1 *shruti*, but if *Pa* is kept on the 13th, and *Ma* on the 9th *shruti*, serious inconsistancies arise, hence *Sa*, the *start*, must be on 0, the Octava, *Sa*, being on the 22nd).

Bharata also states that *vivadi* (dissonant) notes have an interval of 20 *shrutis*, i.e. by inversion, 2. Thus notes on *Shruti*-position 0 and 2, and 0 and 20, are dissonant, (though those on positions 2 and 20 are not dissonant). Sharangdeva's wording is different. He gives the *Sa* — *Pa* consonant interval as a 'separation of' 12 *shrutis*, and the *Sa*—*Ma* consonant interval as a 'separation of' 8 *shrutis*. This clearly shows that when Sharangdeva mentions such separation, his intention is that both the terminal *shrutis* are to be left out of account. Therefore when he gives the test for *vivadis* as a 'separation of' 1 *shruti*, it must be taken to mean that notes on *shruti*-positions and 0 *and* 2 are dissonant and not on position 0 and 1. This is absolutely clear from the context. However, strangely enough, every one without exception, from Clements upto Brihaspati, have taken as a basic fact that successive *shrutis* are dissonant; i.e. those notes on *shruti* positions 0 and 1 are dissonant, and not those on positions 0 and 2. The reason for such an error has been traced and will be given in the sequel: here we have only to stress that **successive *shruti*-positions such as 0 and 1 do not give dissonant notes, but a 2-*shruti* interval such as 0 and 2 is dissonant.** (This was the first major contribution of Abdul Karim Khan made by actual experiments on the *tambura*). If *Sa* is sounded it is *vadi*, and *Pa* and *Ma* on the 13th and 9th *shrutis* are its *samvadis;* similarly if *Pa* is sounded it is *vadi* and *Sa* or *Re* are its *samvadis*. Thus *vadi* and *samvadi* are interchangeable terms, depending on the context.

2. *Swara-Sadharana:* The gist given above about getting 'intermediate' notes by a 2-*shruti* shift upwards or downwards, a process called a *Swara-sadharana,* is taken from Bharata, and the original wording is quite clear-cut and unambiguous. Most other workers have either neglected it or have stated (e.g. Mulay) that it is not clear. An open mind not cluttered with bias, for a *vivadi* interval being or not being of 2 *shrutis*, will not find anything vague there. The conclusions therefrom are stressed again; and are almost exactly the old wordings themselves—

a. a two-*shruti* shift is a very small one
b. it is used to obtain a 4-*shruti* interval from an existing 2-*shruti* interval — *Re-Ga, Dha-Ni*

Therefore a 2 *shruti* interval plus a 2 *shruti* shift gives rise to a 4 *shruti* interval

c. the operation results in intermediate notes
d. the operation results in bringing order in the *grama*.

3. *The position of Sa:* Nothing is mentioned in the old books as to the position of *Sa*, but since the Octave is from *Sa* to *Sa*, it is the tonic or key note and therefore we have given it the *shruti* number 0. Certain books do say that *Sa* is on the 4th *shruti* from *Ni*, but this does not need the assumption that the Octave begins on *Ni* and ends on *Ni*. After all one has to fit 22 *shrutis* to the Octave, keeping the *Sa Pa* and *Sa Ma* intervals at 13 and 9 *shrutis*. If *Sa* is on the starting note, *Ni* will be 4 *shrutis* below the *Sa* (in the Octave) and the meaning is retained.

Some people have asserted that the old scales began on *Ni*, this is unwarranted and in fact leads to complications at a later stage. The reason for this error is connected with:

4. *The order of Shruti-intervals:* The books say *Sa* has 4 *shrutis*, *Re* 3, *Ga* 2 etc. From the above it will be seen that the intervals in *shrutis* are therefore to be taken as *Sa* 3 *Re* 2 *Ga* 4 *Ma* 4 *Pa* 3 *Dha* 2 *Ni* 4 *Sa*. Some persons however take them as *Sa* 4 *Re* 3 *Ga* 2 *Ma* 4 *Pa* 4 *Dha* 3 *Ni* 2 *Sa*. Which is the correct reading can be ascertained from other evidence. The first evidence is the one mentioned above, *Sa* is on the 4th *shruti* from *Ni*. This fixes the order as *Sa* 3 *Re* 2 *Ga* 4 *Ma* 4 *Pa* 2 *Dha* 2 *Ni* 4 *Sa*. Another evidence is found in the experiment on two *vinas*, the experiment called *sarana* (shift), given to demonstrate the 22 *shrutis* for the two *gramas*. The first shift takes the scale down by 1 *shruti*. The second shift takes it down by another one *shruti*, since it is clearly stated that there is a two *shruti* flattening. And these two *shrutis* are stated to make *Ga* sound as *Re* and *Ni* as *Dha*. Therefore the intervals *Re* - *Ga* and *Dha-Ni* are 2 shrutis each. This again shows the scale to be *Sa* 3 *Re* 2 *Ga* 4 *Ma* 4 *Pa* etc. and not *Sa* 4 *Re* 3 *Ga* 2 *Ma* 4 *Pa* etc. There is other evidence too, but this should suffice. The reason for this misinterpretation has been located and will be made clear in the sequel.

5. *The Sarana Experiment:* There are two versions of this experiment — those of Bharata and Sharangdeva. Bharata's wording being clear, almost all writers have based their conjectures on it. Sharangdeva's wording is vague, but Appa Tulsi, relies entirely on it, and deduces therefrom that the 22 *shrutis* are nothing but 22 parts of an Octave; since *Sa* to *Sa* is 2 to 1, each *shruti* is the 22nd root of 2. He says that the 22 wires must be so tuned that each successive wire is at a frequency 22/2 times the frequency of the previous wire. He says this is the "only way a change of *graham* is possible." Bhatkhande quotes him in extenso (anonymously) and stresses his case; however he (Bhatkhande) often casts doubts as to whether Sharangdeva had understood *shrutis;* then again Bhatkhande reverts to the Bharata method. In fact the whole of Bhatkhande's writing on the *shruti* topic is vague, diverse, disconnected and contradictory. The reason will be given in the sequel).

The answer to Appa Tulsi's approach is as follows:

Either Sharangdeva had no clear idea of the *Sarana* experiment (as Bhatkhande states in many places) or he did have. If he had no such idea the matter can be dropped. If he had, one must disentangle his words and get the meaning. He says, each wire is to be tuned a bit higher; how much? Different persons may tune differently — some may not even reach *Pa* after 22 wires, so that the experiment would not be possible. If the wires have to have an interval of 22/2 or of 1,200/22 cents = 54·54 cents between each pair, the blunt answer is, such a thing is impossible? No one can tune by ear correctly, to within an error of say 2 cents an interval of 54 or 55 cents, without reference to auxiliary notes. It is a physiological impossibility. Secondly, if all the intervals are equal, there is no need for 4 *saranas*, one will be enough or even 22 may not suffice. Thirdly, if one can accurately tune the wires in this manner, he has no need for the demonstration. Appa Tulsi's statement about 'change of *graham*' needs no answer because the meaning of *graham* is here distorted: A '*graha*' is a starting note for a musical piece, a *raga* or a *jati* and has nothing to do with scales as such.

To interpret Sarangdeva, only two lines of approach are useful:

1. To take, as translated by Bhatkhande, *Sa, Re, Ga, Ma, Pa, Dha, Ni,* on the 4th, 7th, 9th, 13th, 17th, 20th and 22nd wires, these being also the corresponding *shruti*-positions (with *Ni* = 0 position), the 2nd, 3rd, 5th etc. — intermediate — wires being just stretched to give any higher and higher intermediate frequencies, but without the attention being fixed on them, or,

2. To fill 3 Octaves in the 22 wires = 7 wires for the 7 notes of each Octave and the 22nd (last wire) ending the third Octave. (This is the version Kapileshwari prefers).

In either case, Bharata's experiment and Sharangdeva's become similar. (Bharata does not mention the type of *vina;* it may have had 7 wires and no frets, or at least one wire with at least 7 frets).

The Scale Thesis

The Octave has ratio, 2, 1200 cents, and this tallies with the texts which state that the Octave note (*tara-shadja*) is found on the mid-point of the string; and this covers 22 *shrutis*. Thus 22 *shrutis* = 1,200 cents, ratio 2. The books say the *panchama* is found on 2/3rd of the string length; this has 13 *shrutis*. Thus 13 *shrutis* = 702 cents, ratio 3/2. Consequently, the 9 *shrutis Pa* to *Sa* = 1,200 — 702 = 498 cents, ratio 4/3, and this tallies with the statement that *madhyama* is found on 1/4th the string length.

There is absolutely no logical reason why we should not apply the *vadi-samvadi* rules of 13 and 9 *shrutis*, with the above measures, to get various *shruti* positions in the Octave. If others have fought shy of it, they have presumably been pre-occupied with preconceived notions, since they have not adduced any reasons of this action.

The *Pa* of *Pa* is 13 + 13 *shrutis* = 26 *shrutis* = 26—22=4 *shrutis* reduced to the Octave. This measures 702 + 702 — 1,200 = 204 cents, ratio 9/8. Similarly we get the 17th, 8th, 21st and 12th *shruti* positions at 27/16 ratio 906 cents, 81/64 ratio 408 cents, 243/128 ratio 1,110 cents, and 729/512 ratio 612 cents respectively. None of these give the *shuddha swaras* of the ancients, but the position-numbers and their measures are quite logical, and can be aurally determined by anyone exactly. The 12th, position is the *madhyamagrama panchama*, so that the *pramana shruti* = 13th — 12th *shruti* = 256/243 ratio, 90 cents.

Applying the rule of 9 *shrutis* in similar fashion, (or applying the rule of 13 *shrutis* in descending from *tara-shadja*), we get the following: 18th, 5th, 14th, 1st, 10th, *shruti* positions of 16/9, 32/27, 768/486, 256/243, 1,024/729 ratios or 996, 294, 792, 90, and 588 cents respectively. Here again the interval from the 0 to the 1st position comes to 256/243 ratio, 90 cents.

Arranging in serial order,

Shruti position	0	1	4	5	8	9	10	12	13	14	17	18	21	22
Cents.	0,	90,	204,	294	408,	498,	588,	612,	702,	792,	906,	996,	1,110,	1,200

which yields the following relations —
4 *shrutis* = 204 cents, 3 *shrutis* = 114 cents, 1 *shruti* = 90 cents.

Check where you will, these relations hold constant between any notes.

This also gives a 2-*shruti* interval between positions 12 and 10. Its value is 24 cents. (612 — 588 = 24). It is the interval between the positions obtained by raising *Ma* by 1 *shruti* and lowering *Pa* by 1 *shruti.* It is the *shruti* interval between two *shrutis,* so it is an *antahshruti.*

Thus: 4 *shrutis*= 2 fifths (*Pa*) minus one Octave.
1 *shruti* = 1 fifth (*Pa*) minus 3 such 4 *shrutis,*
3 *shrutis*= 4 *shrutis* — 1 *shruti,*
2 *shrutis*= [4 *shruti* — (1 *shruti* + 1 *shruti*)] an interval between two *swaras* (*swarashruti*)
or 2 *shrutis*= 3 *shrutis* —1 *shruti.* This is an interval between 2 *shrutis,* therefore a minute *antahshruti.*

This gives the 3rd and 16th *shruti* positions at 114 cents and 816 cents respectively. Alternatively one may obtain the 3rd position from the 12th (612 — 498 = 114 cents), and the 16th position from this 3rd (114 + 702 = 816 cents).

The positions derive logically, they can be derived on strings by fifths and fourths and thus demonstrated, they can even be found by voice alone, and it can be ascertained that the resultant notes are currently used musical notes.

We thus get the two *grama* scales and the *shuddha swaras* —

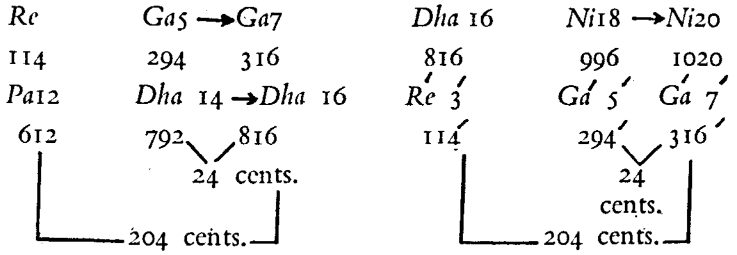
S. Grama Swaras	*Sa*	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*
Shruti position	0	3	5	9	13	16	18	22
Cents.	0	114	294	498	702	816	996	1200
M. Grama Swaras	*Sa*	*Re*	*Ga*	*MaMa*	*GaPa*	*Dha*	*Ni*	*Sa*
Shruti position	0	3	5	9	12	16	18	22
Cents.	0	114	294	498	612	816	996	1200

Ordering these two *gramas* on a 2-stringed *vina* with 7 frets, the 1st string being tuned to *Sa* and the 2nd string to *Ma,* we get *Dha* at the 14th position on *madhyamagrama:*

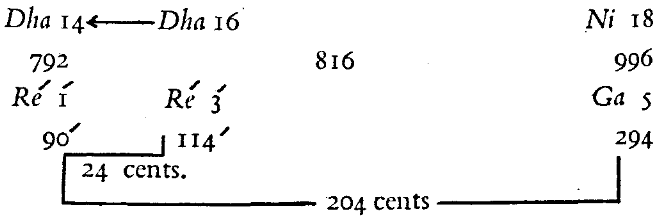
Sa	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*
0	3	5	9	13	16	18	22

Ma	*Pa*	*Dha*	*Ni*	*Sa*	*Re*	*Ga*	*Ma*
9	12	14	18	22	3	5	9

To raise this *Dha*, 14th, 792 cents, to the proper *shuddha Dha* of the 16th position, 816 Cents, we have to shift the second fret. The shift will change the position of *Ga* also in the 1st string, from *Ga* 5 to *Ga* 7. In each case the shift will be of 16 — 14 = 2 *shrutis* or 816 — 792 = 24 cents, a measure already deduced. The *Ga* 7 will be the *Antara Gandhara* of 294 + 24 = 318 cents. Likewise, if we take this *Antara Gandhara* on the sixth fret of the second string, we shall have to shift the fret by 2 *shrutis* = 24 cents. This will result in changing the *Ni* 18 on the first string to *Ni* 20 (*Kakli Nishada* at 996 + 24 = 1020 cents.) We shall get then the 4-*shruti*-intervals *Re* 3 *Ga* 7, *Dha* 16 — *Ni* 20 on the first string, and *Pa* 12 — *Dha* 16, *Re* 3 — *Ga* — 7 on the second string, the measure of these 4 *shrutis* being 204 cents. *Ga* 7 and *Dha* 16 will be consonant, and *Ga* 7 and *Ni* 20 will be consonant, being 9 *shrutis* (498 cents) intervals.



Or, if we take the second-string *Dha* 14 (792 cents) as it is on the fifth fret of the first string, the shift of the fret will be 2 *shrutis* (24 cents) downwards, with the effect that the *Re* 3′ (114′ cents) on the second string will be lowered to *Re* 1′ (90′ cents) The positions 1 and 14 will be consonant and the resulting intervals 1 — 5, 14 — 18 will be 4 *shrutis*.



Likewise we can have the shifts 1-10, 9-11 etc. In each case: (a) the shift is small (24 cents) and has the value of 2 *shrutis*, (b) results in a corresponding 4 *shruti* interval, and (c) given an ordered consonance. Thus all the criteria of *Swarasadharana* are fulfilled. We get

Antara Gandhara *Ga* 7 = 316 cents.
Kakali Nishada *Ni* 20 = 1020 cents.

We also confirm that a 2 *shruti* interval (90 + 90 = 180 cents) + a 2-*shruti* shift (24 cents) = a four-*shruti* interval (204 cents).

It is possible to make this experiment at any time and place, even with the voice. It can be easily perceived that the 2 *shruti* shift of 24 cents is a dissonant interval if used by itself. Hence the *vivadi* nature of 2 *shrutis* can be ascertained. Thus this 2 *shruti* shift of 24 cents enables us to (i) raise a 1 *shruti* interval to a 3 *shruti* interval or lower a 3 *shruti* interval to a 1 *shruti* interval, and to (ii) raise a 2 *shruti* (*Swara shruti*, 180 cent) interval to a 4 *shruti* interval, or lower a 4-*shruti* interval to a 2-*shruti* (180 cent) interval.

The whole scheme is practical, in conformity with the texts, self consistent and logical.

That the resulting notes are musically correct can be theoretically ascertained from any work on musical accoustics (not an elementary physics text book). That they are in use even to-day can be easily ascertained. They will be found to be as under:—

Shruti position 0,0 cents, is the *Sa*
„ „ 9,498 cents, is the *komal Ma*
„ „ 13,702 cents, is the *Pa*
„ „ 22,1200 cents, is the *tara Sa*
„ „ 1,90 cents, is the *komal Re*) as used in
„ „ 5,294 cents, is the *komal Ga*) *Bhairavi,* for
„ „ 14,729 cents, is the *komal Dha*) example
„ „ 18,996 cents, is the *komal Ni*)
„ „ 4,204 cents, is the *teevra Re*) as used in
„ „ 8,408 cents, is the *teevra Ga*) *Yaman* for
„ „ 12,612 cents, is the *teevra Ma*) example
„ „ 17,906 cents, is the *teevra Dha*)
„ „ 21,1110 cents, is *teevra Ni*
„ „ 3,114 cents, is the peculiar
komal Re) as used in
„ „ 16,186 cents, is the peculiar) *Bhairava,*

komal Dha) *Marwa*, etc.
) As used in
) *chhayalaga* and
,, ,, 7,316 cents, is a transient) *Sankirna*
komal Ga.) *ragas* like
,, ,, 20,1020 cents, is a transient) *Todi*, etc.
komal Ni

On *shruti* position 10, 588 cents, will be a peculiar *teevra Ma* as found in *Lalit*, which, close attention will reveal uses **two** *teevra Mas:* at 10, 588 cents and at 12, 612 cents.

If we raise the above *komal Ga*, 294 cents on position 5, by one *shruti* of 90 cents, we shall get a *teevra Ga* which is very nearly the same as the major third, ratio 5/4, 386 cents, of Western harmonic music. This will have position 6, 384 cents. Similarly if we raise the *komal Ni*, 996 cents on position 18, by one *shruti* of 90 cents, we shall get a *teevra Ni* which is nearly the same as the major seventh, ratio 15/8, 1,088 cents, of Western harmonic music. This will have position 19, 1086 cents. These two notes are the old *Sadharana Gandhara* and *Kaishiki Nishada* respectively. The special mention is made because all other 'theorists' hanker after these 5/4 and 15/8. Experiment will show that these are only transitory notes in our music, used in *Chhayalaga* and *Sankirna Ragas*. (Bharata does not mention *Sadharana Ga* and *Kaishiki Nishada;* however, these words and notes are found in books from Sharangdeva onwards. Here the operation enables us to convert a 4 *shruti* interval to a 3 *shruti* interval and vice versa; this is different from the 24 cents *Swarasadharana* of Bharata).

(The Western minor third, 6/5, 318 cents, and minor sixth, 8/5, 816 cents, are our *antara Ga* (nearly) and *shuddha Dha* 16. The Western diatonic semitone 16/15, 112 cents, is nearly our *shuddha Re* 3. The Western major sixth, 5/3, falls on our *shruti* position 15 at 872 cents. The Western minor tone, 10/9, 182 cents, is our 1+1 = 2 *shrutis* nearly. The syntonic comma, 81/80, 22 cents is nearly our 2-*shruti* shift. The Western chromatic semitone 135/128, 92 cents, is nearly our 1 *shruti*).

The whole scheme is thus proof against logic, music, present-day practice, old texts, musical acoustics, and fulfils all the conditions of a scientific theory of freedom from extraneous ideas and biases, self-consistency, a minimum of conjecture and maximum of application and proof. It can be checked.

The scheme can be very properly summarised on the standpoint of musical acoustics, and any person acquainted with that science will at once grant its validity.

The ancient Indian scale system was Pythagorean, i.e. built up by successive fifths and fourths. This system gives major tones (9/4 ratio, 204 cents) as the large intervals and the Greek hemitone or Pythogorean Limma (256/243 ratio, 90 cents) as the smaller interval. The balance between the major tone and the hemitone (204/90 = 114 cents) is the apotome. The consonances thus are very sharp and determinate if attention is focussed on the fourths and fifths, and this makes for correct melody. However if we proceed by steps or degrees the sharpness of consonances varies; so that when necessary one has to flex the scale by tempering for short durations. The tempering interval is the Pythagorean comma of 24 cents. The temperament is thus not cyclic but linear, and cannot be analysed in stepwise fashion by successive notes but must be taken as a whole and the fourths and fifths analysed.

(For the benefit of those not conversant with musical acoustics we must emphasise that the above is a system known for long and acknowledged as perfectly valid in acoustics, physiological acoustics, aesthetics and the psychological side of music dealing with sensations of the tone. The point, that the system is not very well suited for polyphony and useless for harmony, is irrelevant here, and anyway no evidence exists that our music had or now has polyphony or harmony.)

The principle of scale-building, in terms of *shrutis*, can be stated as under:—

Application of the *Sa Pa* relation of 13 *shrutis* (702 cents) results in getting five 4 *shruti* intervals (204 cents) and two 1 *shruti* interval (90 cents) within an octave. If a 4 *shruti* interval is decreased by 1 *shruti* we get 3 *shrutis* (204 — 90 = 114 cents); and for this purpose we can either lower the second note by 1 *shruti* or else raise the first note by 1 *shruti*. Both operations are however not permissible simultaneously:

if such simultaneous raising of the first note and lowering of the second note is performed at all, we get 4 — 2 = 2-*shrutis*, which is a minute interval, (204 — 90) — (0 + 90) = 114 — 90 = 24 cents, between two successive *shrutis* and therefore an *antahshruti*. If we make two successive sharpenings or flattenings of 1 *shruti* each, (90 + 90 = 180 cents), we again reduce the 4 *shruti* interval to this 2 *shruti*-interval; 204 — 180 = 24 cents. In either case the 2 *shruti* interval of 180 cents (the *Swarashruti* interval) or the 24 cents (the *antahshruti* interval) is considered dissonant in our ancient scales. (180 cents nearly equal the minor tone ratio 10/9, 182 cents, and is unsuitable for melody because the 'principle of the leading note' fixes our attention on 204 cents which are derived by the rule of the fifths, and these 204 cents are very near 180 cents, so that the minor tone gets a by-pass).

Thus, in each 4 *shruti* interval, the musically useful tones in an octave are either the 1st note (0 cents) the 1 *shruti* (90 cents) and the 4 *shruti* (204 cents); or, the 1st note (0 cents) the 3 *shruti* (114-cents) and the 4 *shrutis* (204 cents).

If one asks, where is the 2nd *shruti?* The answer is obvious. The temperament goes by fifths, i.e. by major tones as a corollary; it is a linear temperament. In such a temperament one has to go only by differences of 13, 9, 4 and 1 *shrutis* (or consequently by the differences of 5 and 8 *shrutis* as well), (702, 498, 204 and 90 cents and consequently 294 and 408 cents); one is not to seek the serial order of *shrutis* 0, 1, 2, 3, 4, 5, 6, ...20, 21, 22.

Nevertheless, if an answer is demanded it can be as under: the 2nd *shruti* is only an *antahshruti*, 24 cents higher than the 1st note, or 24 cents lower than the 2nd note. In the former case, the upper note (204 cents) is flattened by 1 + 1 *shruti* or 90 + 90 = 180 cents (204 — 180 = 24 cents); in the latter case, the lower note is sharpened by 1 + 1 *shruti* or 90 + 90 = 180 cents (0 + 180 = 180 cents).

1st note	0 *shruti,*	0 cent	*swarashruti*	) difference is an
	2 *shruti,*	24 cent	*antahshruti*	) *antahshruti* 24
				) cents
1st sharp	1 *shruti,*	90 cent	*swarashruti*	) difference is an

2nd flat	3 *shruti*,	114 cent	*swarashruti*	) *antahshruti* 24) cents
	2 *shruti*,	180 cent	*antahshruti*	) difference is an
2nd note	4 *shruti*,	204 cent	*swarashruti*	) *antahshruti* 24) cents

This answer is however meant only for those who do not know the analysis of a linear temperament and who know only cylic temperaments from a reading of elementary books on sound; who are not familiar with enharmonic intervals wherein the lower note sharpened is different from the upper note flattened because successive notes are not necessary harmonic overtones or partials. The knowledge of such persons is confined to elementary information given in books which deal with the major diatonic scale which is necessary for harmony. The correct answer is that a linearly ordered sequence 0, 1, 2, 3, ...21, 22 is not to be sought for *shrutis*.

Again, for the benefit of those who know only the diatonic intervals major tone (204 cents, 9/8 ratio), minor tone (182 cents, 10/9 ratio), diatonic semitone (112 cents 16/15 ratio) and syntonic comma of Didymus (22 cents, 81/80 ratio), we shall restate the principle.

The part left from a major tone by a diatonic semitone, viz. 204 — 112 = 92 cents or 9/8 x 15/16 = 135/128 ratio, is quite a recognised and common interval and is known as a chromatic semitone:—

Now we shall neglect a 2 or 4 cent difference for the sake of this explanation, and equate 92 cents to 90, 112 to 114, 22 to 24. With this accommodation, our principle is that in any major tone we can either have the division (diatonic semitone + chromatic semitone) or (chromatic semitone + diatonic semitone). Two diatonic semitones cannot be accommodated in a major tone, they will be 112 + 112 = 224, i.e. 20 cents or nearly a syntonic comma more. Similarly two chromatic semitones will fall short of a major tone by 204 — (92 + 92) = 20 cents, again nearly a syntonic comma. [With our figures of 90, 114, 180 and 24, the figures which again are recognised intervals for linear temperaments, this relation becomes even more exact (114 + 114) — 204 = 228 — 204 = 24, 204 — (90 + 90) = 204 — 180 = 24]. Thus a diatonic semitone exceeds a major tone by a comma, and 2 chromatic semitones fall short of a major tone by a comma. The comma is a dissonant interval, unavoidable in any temperament which accommodates a minor tone in any way, and its only use is to make the scale flexible for either melody or harmony by slight sharpening or flattening of certain note or notes to suit the musical context. Now our temperament is based upon fifths and fourths, and therefore upon major tones,. we therefore try to avoid minor tones, and if a minor tone arises anywhere we sharpen it by a comma to get a major tone. Straight-forward logic has led us to the equations: major tone = 4 *shruti* interval, minor tone = 2 *shruti* (*Swara-shruti*) interval, diatonic semitone = 3 *shruti* interval, chromatic semitone = 1 *shruti* interval, and comma = 2 *shruti* difference interval (*antahshruti*). On this basis we have been able to interpret, in a rational way, the *shadjagrama*, the *madhyamargrama*, the *swarasadharana* and the effects of a *swarasadharana*, viz., change of a 2 *shruti* interval to a 4 *shruti* interval and the resultant consonance between notes. We have also been able to locate the ancient notes, the current notes, and the notes of Western music. There has been no stretching of ancient words or meaning, no flights of fancy, no hypothesis except that the rule of 5ths and 4ths is applicable throughout the scale. We have been able to show how and why a 2 *shruti* interval is dissonant. We have not taken a single step not sanctioned by physical and physiological acoustics or musical aesthetics, and have throughout kept a watchful eye to ensure that the old texts sanction our conclusions.

It is now easy to proceed to the *Sarana* Experiment. This experiment is in order to give a "demonstration of 22 *shrutis* in the two *gramas*" or in order to "get a test for the purity (i.e. the correctness) of the sound (i.e. notes)." "We have amply elaborated on the fact that the *shrutis* are not to be sought in an ordered array of 1, 2, 3 .... etc.; hence the demonstration is not for the "22 places in the octave," but for showing how and why these places arise, and where. Also if the tallying-points of the *saranas* are not obtained one can see for himself that his ear has deceived him somewhere; so that the *Saranas* must be intended for those whose ear is not perfectly attuned to minute *shruti* differences. Such an ear can correctly judge consonances, fifths and fourths, and is rather vague in respect of other intervals smaller than a major tone.

Therefore the instructions of the *saranas* must be taken to mean instructions based on fifths, fourths, major tones and consonance of any given note with another. It is not correct to interpret a *sarana*-instruction as "lower a note by so many cents" because an ear which can do so does not need the experiment.

The two *vinas* may be with frets or without frets. In the former case even one wire and seven frets each will do, in the latter case at least eight wires were necessary for each *vina*. Mere wires are better for tuning exactly, rather than frets, because with frets, finger-pressure results in distortion due to increase in tension and length. The method being the same however, we shall imagine frets only because the experiment becomes more intelligible that way on paper.

The two *vinas* are identical in the intervals between frets (*samanamurchchana*). The *shadjagrama* intervals are: *Sa* 3 *Re* 2 *Ga* 4 *Ma* 4 *Pa* 3 *Dha* 2 *Ni* 4 *Sa*. The *madhyamagrama* intervals, which are to be set on the second *vina*, are *Sa* 3 *Re* 2 *Ga* 4 *Ma* 3-mg. *Pa* 4 *Dha* 2 *Ni* 4 *Sa*. The one cannot be changed into the other except by performing the *Swara-sadhrana* (shift of a 2 *shruti* small interval) either on *Ga* of the *shadjagramma vina*, or on the *Dha* of the *madhyamagrama* (the former gives *Ga* 5, *Ga* 7, an upward shift, and the latter gives *Dha* 16, *Dha* 14, a down-ward shift). Since the *shadjagrama vina* is the 'standard' one, its notes are preferably to be *shuddha*, so *Ga* is not to be shifted. We therefore change *Dha* 16 to *Dha* 14 on the *madhyama-grama vina* and get, with similarly fret spacing:—

1st *vina* *shadjagrama*	*Sa*	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*
	0	3	5	9	13	16	18	22
Cents.	0	114	294	498	702	816	996	1200

2nd *vina* *madhyamagrama:*	*Ma*	*mg. Pa*	*Dha*	*Ni*	*Sa*	*Re*	*Ga*	*Ma*
	9	12	14	18	22	3	5	9
Cents.	498	612	792	996	1299	114	294	498

We automatically obtain the *mg-Pa*, 12th *shruti*, 612 cents. Now we have to make this "*Pa* a *shadjagrama shruti*"; hence the *Pa-Sa* relation, which is 22 — 12 = 10 *shrutis* in *madhyamagrama*, must be made 9 *shrutis*[1] so that *Sa* becomes 12 + 9 = 21 *shrutis* from the original tonic, a flattening of 1 *shruti.* The instruction therefore means "loosen the string till the note emitted on the fret for *Sa* gives the 9 *shrutis Ma* of this *madhyamagrama Pa*" Frets are not to be disturbed. Hence, when *Sa* is lowered by 1 *shruti* = 90 cents, the second *vina* gives the following sounds:—

	Ma	*Pa*	*Dha*	*Ni*	*Sa*	*Re*	*Ga*	*Ma*
	8	11	13	17	21	2	4	8
Cents.	408	522	702	906	1110	24	204	408

The second fret should give a note which is in unison with the *Pa* of the 1st *vina,* this is the test, and this is the meaning of the words "a *shruti* has been lowered". This is how an ear which knows only 9 to 13 *shrutis* accurately can perform the *sarana.* Here we get a demonstration of 1 *shruti* = 90 cents, and of the *antahshrutis* 9 to 11, 0 to 2, equal to 24 cents each.

The second shift is made in the same way. We have the *madhyamagrama* Pa now of 522 cents, and *Sa* of 1110 cents, a difference of 588 cents or 10 *shrutis.* To make this *Pa* (522 cents), a *shadjagrama Pa,* we must have *Sa* 9 *shrutis* away from it, i.e. on 522 + 498 = 1020 cents. This *Sa* will be lowered once again by 1 *shruti* of 90 cents. The instruction is : "loosen the wire till the sound of the fret for *Sa* is the 9-*shruti Ma* of the (new) *Pa.*" We get —

	Ma	*Pa*	*Dha*	*Ni*	*Sa*	*Re*	*Ga*	*Ma*
	7	10	12	16	20	1	3	7
Cents.	318	432	612	816	1020	1134	114	318

Thus the *Ni* and *Ga* of this *vina* have tallied with the *Dha* 16 and *Re* 3 of the first *vina* exactly. This is the criterion for the use of the untrained ear. Here again we get the *antahshruti* 10 and 1 being 24 cents higher than the 8-*shruti* (present day *teevra Ga*) note, the 21-*shruti* (present day *teevra Ni*) note; while the *antahshrutis* 7 to 20 are already discussed as *antara Gandhara* and *Kakali Nishada.*

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[1] The texts read; "Panchama has been lowered by one *shruti;* make that (Pa) *alone by itself* (*tam-eva*) a *shadjagrama* (*shruti*) by the use of (the principle of) *panchama*" which means Pa 13—Pa 12, Pa 12-Sa 21. The *vina* remains a *Madhyamagrama vina*.

Now, the important point. *Ni* has become *Dha*, and *Ga* has become *Re* as on the standard *vina.* We must take note of these *shuddha-swaras*, and re-christen the above as

	Ga	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*	*Re*	*Ga*
	7	10	12	16	20	1	3	7
Cents.	318	432	612	816	1020	1134	114	318

(because we cannot call 816 cents *Ni* and so on).

For the next shift the instruction does not state a flattening of 1-*shruti*, it says the *Dha* and *Re* must tally (be in unison with) the *Pa* & *Sa* of the 1st *vina*, because "there is a 2-*shruti* difference," we do not have to set *madhyamagrama* or *shadjagrama* on the above, because the intervals now are *Sa* 2 *Re* 4 *Ga* 3 *Ma* 2 *Pa* 4 *Dha* 4, *Ni* 3 *Sa*, which are neither here nor there. The instruction for the ear is thus merely: "loosen the wire till the *Dha* sounds exactly like *Pa* 13 (702 cents) and *Re* 3 like *Sa* (1,200 cents). The shift here is 3-*shruti* 114 cents, and we get —

	Ga	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*	*Re*	*Ga*
	4	7	9	13	16	18	22	4
Cents.	204	318	498	702	816	996	1200	204

which must be re-christened, as argued above as,

Re	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*	*Re*
4	7	9	13	16	18	22	4

The instruction for the fourth and last shift is *Ma* — *Ga*, *Pa* — *Ma*, *Sa* — *Ni*; hence this shift is 204 cents or 4 *shrutis*; and we get

	Re	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*	*Re*
	0	3	5	9	12	14	18	22
Cents.	0	114	294	498	612	792	996	1200
			(= *Ga*)	(= *Ma*)			(= *Ni*)	

since this is the last shift, re-christening is redundant.

Thus the *saranas* enable the checking, by an untrained ear, whether his original notes (wires or frets) were correctly set, they demonstrate how a 1 *shruti*, a 3 *shruti* and a 4 *shruti* interval arises, and what is the meaning of an *antahshruti* (of 24 cents) and how it can occur above or below a given note. The *saranas* do not give 22 separate positions.

Sharangdeva's instruction to take the *swaras* on the next wire at a time checks, if we look to the above tabulations. Take the three *swaras*, *Ma* 9, *Mg Pa* 12 and *Pa* 13. In the *madhyamagrama vina*, *Pa* 12 was on the 1st fret. Next it became 13 on the 2nd fret. Then *Pa* 12 was taken on this 2nd fret. Next *Pa* 13 was taken on the 3rd fret. Lastly this *Pa* 13 shifted to the fourth fret. (A certain vagueness about this does, however, exist).

The *saranas* cannot give 22 separate *shrutis* unless the shifts are made of the order of 22 or 24 cents, 77 or 66 cents and 90 cents. But such shifts require a trained ear, for whom the experiment is redundant. Further, theoreticians who tried to evolve such values have not been able to decide first as to what the scale was. Failing the scale, it is no use proceeding to *saranas*. We have established the scale on an independent basis, proof against verbal hairsplitting : the *saranas* must follow. The above seems the most rational interpretation[1].

4. The Scale Thesis: Critique

As stated above, all other theoreticians have had an approach similar to that of Clements and Deval.

The essentials of these works are: (1) an utter reliance on the hypothesis that the major diatonic scale must have had something to do with our basic ancient scales; (2) a firm belief that the major third, ratio 5/4, 386 cents, being an upper partial, must exist in our scale, since it is a natural note. (We have shown, and anyone can check, that our *teevra Ga* is the *teevra Re* of *teevra Re*, i.e. 2 major tones = 408 cents, and that this 'sacred' 5/4th occurs in our music only as a peculiar *sadharana gandhara.*)

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[1] The above interpretation of *sarana* is not Kapileshwari's.

Further, since 4 *shrutis* = major tone 204 cents (9/8), these persons argued that 3 *shrutis* must be slightly less than this, 2 *shrutis* still less, and one *shruti* still less. Having accepted the major third of 386 cents (5/4) as a must, a minor tone was inescapable because 386 — 204 = 182 cents. This showed our music had a major and a minor tone as "essentials", thus a syntonic comma of 22 cents became inevitable, so also a diatonic semitone of 112 cents. The hypothesis that 3 *shrutis* = 182 cents, minor tone, 2 *shrutis* = 112 cents diatonic semitone, 1 *shruti* = syntonic comma, 22 cents, thus became irresistible and was adopted. Since the 'sacred' major third of 386 cents was a major tone plus a minor tone, its value came to 4 + 3 = 7 *shrutis*, so that 7 *shrutis*, 13 — 7 = 6 *shrutis*, 9 — 7 = 2 *shrutis* and 22 — 7 = 15 *shrutis* became consonant intervals (and not 5 *shrutis* and 8 *shrutis*). Since *Ma* 9 *shrutis*=498 cents and *Pa* 13 = 702 *shrutis* were inescapable, *Ga* 5 *shrutis* = 294 cents was a must, so *Ga* 7 — *Ga* 5 = 386 — 294 = 92 cents, the chromatic semitone, was also granted as a 2 *shruti* interval used "sometimes". The question was, how to fit all this into the system of 3 — 2 — 4 — 4 — 3 — 2 — 4 *shrutis*.

The diatonic major scale is

Notes	*C*		*D*		*E*		*F*		*G*		*A*		*B*		*C*
Ratios.	1		9/8		5/4		4/3		3/2		5/3		15/8		2
Cents.	0		204		386		498		702		884		1088		1200
Cents Steps.		204		182		112		204		182		204		112	
So-called *Shruti* Steps.		4		3		2		4		3		4		2	

Various 'theories' thus arose to interpret this anomaly:—

(1) C corresponds to our *shuddha Ni*, D to *Sa*. The scale is D to D (Clements, DeVal, Achrekar, Framji).

(2) The ancients did start their octave on *Ni* itself and not on *Sa* at all; their open string was *Ni* (Mulay).

(3) The old scale was D to D, but after the Muslim invasion some revolution took place and we now have the scale C to C (Mulay, Metha, Bhatkhande, Omkarnath).

(4) Nothing need be changed, the ancient scheme was *Sa* 4 *Re* 3 *Ga* 2 *Ma* 9 *Pa* .. and not *Sa* 3 *Re* 2 *Ga* 4 *Ma* 4 *Pa* .. (Bhatkhande and others).

(As a corollary:— The old octave was that of *Kafi*. The old octave was that of *Bilawal*. 3. The old octave was that of *Kafi*, but some revolution took place and now it is no longer *Kafi* but *Bilawal*. (4) The old Octave was *Bilawal* and now it has become *Kafi*).[1]

Then again, the A of ratio 5/3, 884 cents, conflicted with the *shruti* order 4-3-2-4-4-3-2 for *shadjagrama*. It had therefore to be raised by "1 *shruti* of 22 cents", and became 27/16, 906 cents, 17th *shruti*.

Now came another controversy. Those who said the old "D" is the present *Sa* could assert that the old A was the same as the present *Dha* and therefore old *Pa*. The old *madhyamagrama Pa* was then 5/3, *shadjagramapanchama* being 27/16. Others who stated *Pa* was the same throughout, viz., 3/2 (G), had to put *madhyamagramapanchama* at 3/2 x 80/81 = 240/162, 702 — 22 = 680 cents.

The temperament being cyclic, a linear order of *shrutis*, 0, 1, 2, 3, 4 .... 22 began to be sought. For this purpose, the *sarana* experiment was invoked — on paper. 22 cents = 1 *shruti* as the first shift was of course granted. The idea was that in the four successive shifts, *Pa* 13 becomes 12, 11, 10 and 9 *shrutis*. Now 13 — 12 = 22 cents, and so 204 — 22 cents (= 182 cents) remained to accommodate the remaining three shifts. 22 x 3 was too small, so various 'theories' came into being. For example, whether to take the first 22 cents shift for *Re* as (204 — 22) cents or (182 — 22) cents and so on.

Prof. V. G. Paranjpe dressed out some simple algebra and "proved" that the four shifts were of 22, 90, 70 and 22 cents respectively. As musicians do not know mathematics, and mathematicians usually do not bother about the 'theories' of music along with Sanskrit jargon, the proof was acclaimed as a major piece of research. But again, since a "minor tone had only 3 *shrutis*", the question came as to whether the shifts for a minor tone should be 22, 90 and 70 or 90, 22 and 70, and so on and "*shruti* tabulations" began. Different names were given to these cent-values since all these "represent one *shruti*".

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[1] However, no practicing musician will admit using minor tones either in *Kafi* or in *Bilawal*. On this and such other points, Abdul Karim Khan dissociated himself from Clements & Deval.

Pandit Omkarnath for example has stated that if we take successive fifths twelve times, we do not reach the octave, but exceed it by 1 *shruti* whose value is 22 cents (81/80), the Didymus ' comma. He then tabulates the 22 *shrutis* by the above procedure. Any one can see that the excess is indeed 22 (or rather 24 cents), but the *shruti* value is not 1 but 2 : 13 x 12 = 156 *shrutis* = 156/22 = 7 octaves and plus 2 *shrutis*, not 1; also 702 cents x 12 = 8,424 cents = 7 octaves + 24 cents. Even on the basis of what he writes, he should have realised that 22 (or 24) cents equals 2 *shrutis* and not 1, and this 2 *shruti* interval is dissonant.

There is nothing further done in this respect. Even criticism is superfluous; but a lot of harm has been done, so comments become necessary.

Firstly, witness that the whole structure is one of hypotheses. No experiments were performed. Clements and Devals' monochord experiments led them to frustration because they did not get musicians' sanction to minor tones. Inspite of this warning, others pressed on with the same hypotheses. The real fact that our music used a double major tone, 408 cents, for *teevra Ga* did not deter them from asserting that the ancients, at any rate, must have used 386 cents. Thirdly, conjectures about 'revolution during Muslim rule' led to the impression that present-day music is something different, and that South Indian music is more true to the old texts and therefore entirely separate from other Indian music. (Bhatkhande holds entirely to this view). The real meaning of *Sadharana* and *antara gandhara* and of *Kakali* and *Kaishika nishada*, was entirely lost, as also the purpose for which they were given. Naturally *madhyamagrama* ceased to have any meaning in these contexts.

But the worst harm done was to the cause of music itself. The major diatonic scale, whose notes (except for F, our *Ma*, taking C-

Sa) nearly approach-with small differences — our present *teevra* notes, having been taken as the ancient scale, and since the notes of the ancient basic *shadjagrama* scale were called *shuddha* notes, it became the fashion to equate *shuddha* with *teevra*, except for *Ma*, which is called *shuddha* at the 9th *shruti* or sometimes *komala*, and *teevra* on sharpening. This confusion of the old *shuddha* with modern *teevra* made a rational reading of old books impossible, and led to various theorisations. (We have amply demonstrated that the old '*shuddha*' is the modern '*komala*', except for *Pa;* the old *madhyamagrama Pa*, is the modern *teevra Ma*). The second tragedy is in respect of intonation. The real meaning of *shruti* - relations having been obscured, the whole of the basic structure has been thrown aside, and new 'systems' based on the diatonic scale have arisen, which of course cannot attend to the fineries of the consonances of 13, 9, 8 & 5 *shruti* intervals which are so essential to melody. The ancient system of *murchchanas* (change of Key) having been thrown overboard, improvisations have become stereotyped and monotonous. This had its reaction on the part of 'classically trained family musicians,' who naturally stuck to their own tradition, so that two types of 'classical' music arose — the traditional and the one taught in schools. The net result in the long run was, newfangled music-forms arose, especially in the cinema world, and this type of music knowing no limits and being free to express itself anyhow it pleased, was far from tedious, with the result that the popular appeal of classical music as a whole has begun to die out.

The mistake arose with the reverence for 5/4 and the diatonic scale. If Clements and Deval had only read their Helmholtz, from which they drew upon, carefully, they would have seen their error, 5/4 may be a partial but is not a perfect consonance. It came into Western music, even, at a very late date, bringing the diatonic scale with it. It became indispensable for harmony no doubt, but not for melody which is the only thing our music knows. The human ear, playing or singing one-part (solo) music without accompaniment, prefers notes higher than 5/4, round about 400—410 cents, 408 cents, the Pythagorean major third, held sway for melody and even to-day is recognised as such. All these things, which every musical acoustician knows, are already there in Helmholtz's book (about 1884). Further, if Clements and Deval wanted a link-up with the outside world, they could have had a sense of history: Bharata wrote certainly not later than 300—600 A.D., and should have been compared not with the Diatonicians, but with old Arabic, Persian and Greek musicians: their scales are given in detail by Helmholtz and his translator, Ellis, as resulting from actual experiments, - and they have Pythagorean and similar scales, not using ratios of 5/4, 6/5, 8/5, 15/8 and so on.

Theorists coming after Clements and Deval borrowed their knowledge from the former, and the blunders multiplied.

Bhatkhande was the only exception: he seems to have realised that we do not use 5/4 but 81/64, not 5/3 but 27/16. But he seems to have been reconciled to the diatonic scale. Further, his main objective being to list *ragas*, to classify them and to describe them, he had to draw upon medeival books (ca. 1600 or so) only in some of which the *shuddha-teevra* terminology crops up; he was also enamoured of Venkatamakhi because of his classification system; so that instead of taking the basis from the ancients (Bharata etc.) and tracing it down to Venkatamakhi, he somehow put everything together. The result is a mix-up of the *shuddha-teevra* terminology along with some vague mention of *shruti* stipulations, with consequent entanglements. Therefore every time he cites an old reference he has to withdraw into his own shell and — finally quote only Appa Tulsi and Chaturapandita as authorities. Hence his *ra ga* system had to be content only with an enumeration of *vadi*, *samvadi*, other notes used, and the ascents and decents within an octave. The 'System' thus became lopsided, and what could have been the greatest triumph fell short.

The net result of all the above situation has been, such a firm rooted belief in the Clements' et al, and Bhatkhande's and other theories, that any original logical experimental work like that of Kapileshwari is neglected. The following points especially are considered sacriligeous:—

1. It is a 2 *shruti* interval that is non-musical.
2. *Shrutis* are not ordered in serial order.
3. In a major tone we can locate only one musical interval.
4. Minor tones are not regular intervals in our melodies. They (minor tones) are 2 *shrutis*.

5. We have the Pythagorean major third, and not the 5/4, as our *teevra Ga.*
6. The ancient basic scale was similar to our *Bhairavi*, not *Kafi* or *Bilawal.*
7. 3 *shruti* intervals give *komala swaras*, not *teevra.*
8. A one-*shruti* interval is a 'must' in any octave. Its value is immutable.
9. Our consonances go by 22, 13, 9, 8, 5 *shrutis* and not 22, 13, 9, 7 & 6 *shrutis.*
10. The ancients' *shuddha swaras* are our present *komala*, not *teevra.*
11. No major revolution took place, neither any major basic cleavage with South India, after the Muslim invasion.

We end this section by summarising points on which Kapileshwari's work should be acceptable to other 'theories' if they want a common ground:

Kapileshwari	**Value**	**Others**
1. *Shruti* = 90 cents Musical interval *komala*	Chromatic Semi-Tone	2 *shrutis* = 92 cents, musical; *komala*, but in the 2nd shift of the *saranas*, 1 *shruti* = 90 cents.
2. 2 *shrutis* = 180 cents, an 'incidental' interval only. Nearly *teevra*	Minor Tone.	3 *shrutis* = 182 cents, a musically necessary interval. Nearly *teevra.*
3. 2 *shrutis* difference = 24 cents, a dissonant interval used for flexing the scale only.	Comma	1 *shruti* = 22 cents. used for *shruti* locations. Musically useless.
4. 3 *shrutis* = 114 cents. Musical interval, *komala*	Diatonic Semi-Tone	2 *shrutis* = 112 cents. Musical interval, *komala.*
5. The diesis of 66 cents arises only by difference, and has no musical relevance.	Diesis	70 cents is a step in one of the *saranas*, its value is 1 *shruti*, musically irrelevant.

The Grama and Murchchana Thesis

It has been demonstrated that, for the actual practice of music, only 4 and 1 *shruti* intervals will be useful in our music, because it is only by a suitable combination of such intervals that we get all notes of an octave consonant in pairs. In fact the *swarasadharana* has been laid down to get such consonances of 9 and 13 *shrutis* by changing a 2 *shruti* interval to a 4 *shruti* or a 3 *shruti* interval to a 1 *shruti* interval. Thus in the *shadjagrama*, *Ga* 5 is not consonant with *Dha* 16, it is consonant with *Dha* 14, 4 *shrutis* below the *Ni* 18. *Ga* 7 is 4 *shrutis* above *Re* 3, and is consonant with *Dha* 16, but not with *Ni* 18 — it is consonant with *Ni* 20, 4 *shrutis* above *Dha* 16. But this *Ni* 20 is not consonant either with *Ma* 9 or *Sa* 22. Similarly with the *madhyamagrama*. To secure maximum consonance, we must reduce the *Dha* 16 and *Re* 3 of *shadjagrama* to *Dha* 14 and *Re* 1. This will shift, automatically, the mg. *Pa* 12 to 10, and the *Re* 3 to *Re* 1, in *madhyamagrama*. We get :

S-grama.	*Sa*	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*
shruti	0	1	5	9	13	14	18	22
Cents	0	90	294	498	702	792	996	1200

M-grama	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*	*Re*	*Ga*	*Ma*
shruti	9	10	14	18	22	1	5	9
Cents	498	588	792	996	1200	90	294	498

Here *Sa* 0 + 9 = *Ma* 9, *Sa* 0 + 13 = *Pa* 13; *Re* 1 + 9 = *Pa* 10 in *M-grama*, *Re* 1 + 13 = *Dha* 14; *Ga* 5 + 9 = *Dha* 14, *Ga* 5 + 13 = *Ni* 18, so that every note has a pair of *samvadis*. Now the scales are musically tuneful.

The *gramas* are a system of arranging the notes in corresponding order, so that one *grama* can react on the other and lead to a consonant scale; the *grama* scales permit mutual *swarasadharana* and the location of proper tones by *shruti*-intervals. But they are not scales to be sung or played: they must be made consonant if they have to be made use of in actual music.

It can be seen that the *shadjagrama* basic consonant scale is exactly the same as the scale of our modern — *Bhairavi* (or *Mukhari* as it is called in South India), and the *madhyamagrama* basic consonant scale is the same *Bhairavi* with the *Pa* left out, and a *teevra Ma*, such as is used in *Lalat*, being used instead. (This *teevra Ma* is not the one used for *Yaman*, but a bit flat by a comma; *Lalat* uses both these *teevra Ma's*).

The third *grama*, the *gandharagrama*, is not mentioned in Bharata. However; rather sketchy descriptions of it are found in *sharangdeva* (1200), Damodar (1400-*Sangitadarpana*) and Narada (1500 - *Sangitamakaranda*). It seems that in this *grama* we must have:—

1. A 3 *shruti Gandhara* on the open string.
2. *Ga* to take 1 *shruti* of *Re*.
3. *Ga* to take 1 *shruti* of *Ma*.
4. *Dha* to take 1 *shruti* of *Pa*.
5. *Ni* to take 1 *shruti* of *Dha*.
6. *Sa* has a 3 *shruti* interval, or *Ni* takes 1 *shruti* of *Sa*.

If the 3 *shruti Ga* is taken as *Re* = 114 cents + 114 cents, we get a musically impracticable gamut starting on 228 cents which is dissonant with both the other *gramas*. If we raise the *shuddha Ga* 5 by 3 *shrutis* we get *Ga* 8, the Pythagorean *Ga*, which is consonant with *Sa* and *Pa*. Also this *Ga* 8 is 1 *shruti* below *Ma* 9, and can be said to "take 1 *shruti* of *Ma*". Similarly a *Ga* 4 can be said to "take 1 *shruti* of *Re* 3." Thus we have (provisionally) the *shruti* positions 4 and 8. *Ma* 9 and *Pa* 13 are supposed to be there. *Dha* is 3 *shrutis* higher than *Pa* 13, when it takes "1 *shruti* of *Pa*" it becomes *Dha* 17. When *Ni* takes 1 *shruti* of *Sa* it becomes *Ni* 21, while *Ni* 18 is 1 *shruti* higher than *Dha* 17. *Ni* therefore is *Ni* 18 and/or *Ni* 21. The scale becomes.

	Ga	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*	*Re*	*Ga*
	8	9	13	17	21 or 18	22	4	8
Cents	408	498	702	906	1110 or 996	1200	204	408

Comparing with the consonant scales of the other *gramas*, *Ni* 18 has to be omitted. Thus the consonant scale of *gandharagrama* is *Ga* 8, *Ma* 9, *Pa* 13, *Dha* 17, *Ni* 21, *Sa* 22, *Re* 4, *Ga* 8 — our modern *Bilawal*.

Or we may employ *madhyamagrama* to set this scale, when we have

	Dha	*Ni*	*Sa*	*Re*	*Ga*	*Ma*	*Pa*	*Dha*
	17	18	22	4	8	9	13	17
Cents.	906	996	1200	204	408	498	702	906

the present-day *Jhinjoti.*

Kapileshwari prefers *Jhinjoti* to *Bilawal* in the above.

Summing Up

S-grama	0	1	5	9	13	14	18	22
M-grama	9	10	14	18	22	1	5	9
G-grama	8	9	13	17	21	22	4	8
or	17	18	22	4	8	9	13	17

Thus all the three *gramas* are interconnected. Between them they give all the musically-useful main notes:

0, 1, 4; 5, 8, 9; 10, 13; 14, 17; 18, 21; 22.

Plus the mg-*Pa* of 12 *shrutis*. These, along with the *antahshrutis* obtained by raising or lowering them by 2 (24 cents), which are transient or incidental notes, is our basic structure.

In the above, *M-grama* is obtained by changing the Key-note (tonic) from 0 to 9 and taking from it the same order of intervals 1- 4- 4 -4- 1- 4-4.

But we can as well start with 9 as before and instead of repeating the above intervals, can repeat the notes themselves — 9, 13, 14, 18, 22, 1, 5, 9. The intervals taking 9 as the *Sa*, will become 4- 1- 4- 4- 1- 4- 4 or the *shruti* positions with 9 = 0 will be 0, 4, 5, 9, 13, 14, 18, 22; which will be exactly the same as our present *Jaunpuri.* The *Bhairavi* sung with *Ma* as *Sa* becomes *Jaunpuri.* This process is called *murchchana.* The old books state that the *Sa* of *shadjagrama* is found at the *madhyasthana* i.e. middle of the string, and *murchchanas* are to be carried out upward and downward starting from this *madhyasthana.* Thus the first *murchchana* is of course *Bhairavi,* the second starts from *Ni* 18, the third from *Dha* 14, the fourth from *Pa* 13, the fifth from *Ma* 9, the sixth from *Ga* 5, the seventh from *Re* 3. There are 7 *murchchanas* for each *grama.* The 3 *gramas* will thus have 7 x 3 = 21 *murchchanas*. However, these are interconnected and therefore duplicate each other, as will be clear from the tabulation below:

Shadjagrama-murchchanas

(1) from *Sa* (name *Uttaramandra*): present-day *Bhairavi*

Sa	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*	Cents
0	1	5	9	13	14	18	22	need not now be given

(2) from *Ni* (name *Rajani*): *Kafi*

	Ni	*Sa*	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*
	18	**22**	1	5	9	13	14	18
=	*Sa*	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*
	0	4	5	9	13	17	18	22

(3) from *Dha* (name *Uttanayata*): *Bilawal*

	Dha	**Ni**	**Sa**	*Re*	*Ga*	*Ma*	*Pa*	*Dha*
	14	**18**	**22**	1	5	9	13	14
=	*Sa*	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*
	0	4	8	9	13	17	21	22

(4) from *Pa* (*Shuddhashadja*) — *Panchama*-less *Bhairavi* type.

	Pa	**Dha**	**Ni**	*Sa*	*Re*	*Ga*	*Ma*	*Pa*
	13	14	18	22	1	5	9	13
=	*Sa*	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*
	0	1	5	9	10	14	18	22

(5) from *Ma*, *Matsarikrita* — *Jaunpuri.*

	Ma	**Pa**	**Dha**	**Ni**	*Sa*	*Re*	*Ga*	*Ma*
	9	**13**	**14**	**18**	**22**	1	5	9
=	*Sa*	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*
	0	4	5	9	13	14	18	22

(6) from *Ga*, *Ashwakranta* —*Jhinjoti*

	Ga	**Ma**	**Pa**	**Dha**	**Ni**	*Sa*	*Re*	*Ga*
	5	9	13	14	18	**22**	1	5
=	*Sa*	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*
	0	4	8	9	13	17	18	22

(7) from *Re, Abhirudgata* — *Yaman*

	Re	**Ga**	**Ma**	**Pa**	**Dha**	**Ni**	*Sa*	*Re*
	1	5	9	13	14	18	22	1
=	*Sa*	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*
	0	4	8	12	13	17	21	22

Madhyamagrama-murchchana

(1) from *Ma, Souveri* — *Bhairavi*

	Ma	*Pa*	*Dha*	*Ni*	*Sa*	*Re*	*Ga*	*Ma*
	9	10	14	18	22	1	5	9
=	*Sa*	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*
	0	1	5	9	13	14	18	22

(2) from *Ga, Harinashwa* — *Kafi*

	Ga	**Ma**	**Pa**	**Dha**	**Ni**	*Sa*	*Re*	*Ga*
	5	9	10	14	18	22	1	5
=	*Sa*	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*
	0	4	5	9	13	17	18	22

(3) from *Re, Kavalopanata* — *Bilawal.*

	Re	**Ga**	**Ma**	**Pa**	**Dha**	**Ni**	*Sa*	*Re*
	1	5	9	10	14	18	22	1
=	*Sa*	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*
	0	4	8	9	13	17	21	22

(4) from *Sa, Shuddhamadhya* — a *panchama*-less *Bhairavi type.*

	Sa	**Re**	**Ga**	**Ma**	**Pa**	**Dha**	**Ni**	*Sa*
	0	1	5	9	10	14	18	22

(5) from *Ni, Margi* — *Jaunpuri.*

	Ni	**Sa**	**Re**	**Ga**	**Ma**	**Pa**	**Dha**	*Ni*
	18	22	1	5	9	10	14	18
=	*Sa*	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*
	0	4	5	9	13	14	18	22

(6) from *Dha, Pouravi* — *Jhinjoti.*

	Dha	**Ni**	**Sa**	**Re**	**Ga**	**Ma**	**Pa**	*Dha*
	14	18	22	1	5	9	10	14
=	*Sa*	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*
	0	4	8	9	13	17	18	22

(7) from *Pa, Hrishyaka — Kalyan*

	Pa	**Dha**	**Ni**	**Sa**	**Re**	**Ga**	**Ma**	*Pa*
	10	14	18	22	1	5	9	10
=	*Sa*	*Re*	*Ga*	*Ma*	*Pa*	*Dha*	*Ni*	*Sa*
	0	4	8	12	13	17	21	22

And similarly one can arrange the *Gandharagrama Murchchanas* —

Other types of *murchchanas* are also described in the books: they are the *Sadharanakrita murchchanas,* comprising *sakakali* (in which the *kakali Ni* 20 is used instead of the *shuddha Ni* 18), *santara* (in which the *antara gandhara Ga* 7 is used instead of the *shuddha Ga* 5), and the *sakakalyantara* (in which both *Ga* 7 and *Ni* 20 are used). This is however a matter of detail.

On the basis of these musically-useful scales, musical pieces were to be played or sung. They were the *Jatis* (types or modes) and were given the names *Shadji, Arshabhi* etc. (i.e. resulting from *Sa, Re* etc.). Other poetical names are also found.

It will be seen, from the above-mentioned similarity of the *murchchana*-scales with the modern *raga* scales, that our present *ragas* have direct connection with the old *Jati* system.

This matter of *murchchanas* has also been tackled by other theorists, but the difference between their work and Kapileshwari's is as follows:—

(1) The *shruti*-values naturally differ.

(2) Kapileshwari first makes *grama* scales consonant and then proceeds to *murchchanas* for reasons of musical practicability.

(3) Kapileshwari points out that '*madhyasthana*' means the mid-point of the string; others take it to mean *Sa* or *Ma.* Thus the order of *murchchanas* changes.

(4) Kapileshwari's sequence is *Sa, Ni, Dha* .. for *Shadjagrama, Ma, Ga, Re, Sa* .. for *Madhyamagrama, Dha, Pa, Ma*. .for *Gandharagrama* (or *Ga, Re, Sa* .. for *Gandharagrama*). The others have taken it variously as *Sa, Re, Ga* .. for *Shadjagrama; Ma, Pa, Dha* .. for *Madhyamagrama,* or even *Ma, Pa, Dha,* .. and *Sa, Re, Ga,* .. for *Shadja* and *Madhyamagrama.*

The really important points are the first two. Kapileshwari's work shows a direct relation between *murchchanas* and *ragas* by locating notes which can be demonstrated as being in actual use in *ragas* today and being the notes of the old consonant *grama* scales.

Continuity of Tradition

The next theme is to visualise whether the above system, existing at the time of Bharata, underwent modifications, if so, how and when. For this we have to go in the chronological order of books.

Bharata's work does not mention "Vikrita". He gives seven *shuddha* notes (our present *komala*), plus the *madhyamagrama panchama* (our present *teevra Ma*), and *antara gandhara* (nearly 6/5) on the 7th *shruti* and *Kakali nishada* (nearly 9/5) on the 20th. Thus he gives only 7 + 1 + 2 = 10 notes. However, he gives the procedure of *swarasadhana* which enables us to obtain incidental notes by getting 4 *shruti* intervals at desired places in Octave with the aid of a 2 *shruti* (24 cents) sharpening or flattening. He has no names for such notes, because they can have any number.

Sharangdeva (1200 A.D.) seems to have performed this *Swarasadharana* throughout the Octave, and thus arrived at 19 notes. Starting with the *shuddha* notes of Bharata; he mentions 12 more, which he calls *vikrita* varieties of notes. He states "*shadja* becomes *vikrita* in two ways, *chyuta* and *achyuta*, by 2 *shrutis*, and can be perceived in the *sadharana* and *kakali* type of *Ni* when *Re* takes up the *shruti* of *Sa* in *sadharana*, it becomes 4 *shruti* and then *vikrita* by one (*shruti*). *Sadharana* has 3 *shrutis*, *antara* 4, *gandhara* has two well known varieties without doubt. *Ma*, like *Sa*, is of two types, depending on *antara* and *sadharana*. In *madhyamagrama*, *Pa* is 3 *shrutis* in *Kaishika*, and assuming the *shruti* of *Ma* becomes 4 *shrutis:* thus two types. *Dha* in *madhyamagrama* is *vikrita* on 4 *shrutis*. *Ni* is 3 and 4 *shrutis* in *Kaishika* and *Kakali*. Thus twelve (notes) become *vikrita* (thus of two varieties), and these along with the seven *shuddhas* make nineteen."

The wording in some ways is indeed vague and ambiguous, but most of the sentences are clear. For example the wording about *Pa* reads:— *Pa* 13 becomes *Pa* 12 in *madhyamagrama*, this is 3 *shrutis* from the lower *shuddha* note, *Ma* 9 (*Kaishika Pa*). If we lower *Ma* 9 by 1 *shruti* to *Ma* 8, this *Pa* 12 becomes 4 *shrutis* again. Similarly the *shuddha Dha* 16 is 4 *shrutis* from this *Pa* 12 and therefore should be called *vikrita;* (on the other hand, we get a *Dha* 14 at 4 *shrutis* from *Pa* 12, as also a 4 *shruti Dha* at 17 from *Pa* 13). We thus interpret the above passage thus:—

Shuddha:	*Sa*	0	(0 cents)	*Vikrita:*	*Chyuta Sa*	**21**	(1110 cents)
					Vik. Re	1	(90)
	Re	3	(114)		*Vik. Re*	4	(204)
	Ga	5	(294)		*Sadharana Ga*	6	(318)
	Ma	9	(498)		*Antara Ga*	7	(384)
	Pa	13	(702)		*Chyuta Ma*	8	(408)
					Vikrita Pa	10	(588)
	Dha	16	(816)		*Kaishika Pa*	12	(612)
	Ni	18	(906)		*Vikrita Dha*	14	(792)
	Sa	22	(1200)		*Vikrita Dha*	17	(906)
					Kaishika Ni	19	(930)
					Kakali Ni	20	(1020)

Total 19.

It is hereby apparent that Bharata's scale system has remained the same, but the various *shruti* positions, obtained from raising or lowering a note by 1 *shruti* in order to create 4 and 3 *shruti* intervals, have been given different names: the word *vikrita* is given to them as categories, the word *chyuta* has appeared, *sadharana* (which was the name for a process in Bharata) is now an adjective for *vikrita* notes, the names *antara* and *kakali* have been retained, the *kaishiki* is again an adjective for *Pa* and *Ni* varieties (whereas Bharata only meant 'very fine' by *Kaishiki*). Thus in the period of at least 600 years, betwen Bharata and Sharangdeva, the only change was this terminology. We also find the phrases: 'accepting — or assuming or taking — the *shruti* of' the lower note, which however does not denote a new procedure.

There is however another way of reading the passage, wherein the same note can be called *shuddha* from one angle and *vikrita* from another angle. Thus *Dha* 16 is a *shuddha* note and 3 *shrutis* higher than *shuddha Pa* 13; in *madhyamagrama Pa* is flattened to *Pa* 12, and *Dha* 16 becomes 4 *shrutis* away from it and hence, without changing its frequency becomes *vikrita*. The same *Dha* thus can be called *shuddha* or *vikrita* depending on how we look at it. If the above view is taken, we have to omit the notes *Pa* 10 (588 cents) and *Dha* 14 (792 cents) from the list; so also the notes *Re* 1 (90 cents), *Ga* 7 (318 cents), *Ga* 6 (384 cents), *Ni* 20 (1020 cents) and *Ni* 19 (930 cents). Thus the number of *vikrita* notes reduces from 12 to 5, and the total number of specific notes in the octave comes to 7 + 5 = 12.

This is the view taken by Ramamatya about 1500, i.e. 300 years after Sharangdeva. Ramamatya says: "It is true, Sharangdeva gave 12 *vikritas*, but I say they are only five; why? These *vikritas* are the varieties of the seven *shuddha* notes: now, if we lower the starting note, (i.e. depress it by 1 *shruti*, say), the original higher notes themselves become *vikrita* and nothing much is gained. Differences can arise by taking the *shruti* of the previous note or by omitting the previous *shruti* (viz. at *Sa* = 0, by making either 0 = 21 or 0 = 1); and in keeping the starting note unchanged, we do not lose our objective."

Thus Ramamatiya's notes becomes :—

shuddha Sa 0 (0 cents)	Called	*shadja*
shuddha Re 3 (114 cents) or *Re* 1 (90 cents)	,,	*shuddha rishabha*
vikrita Re 4 (204 cents)	,,	*panchashrutika rishabha*
shuddha Ga 5 (294 cents) or *Ga* 7 (318 cents)	,,	*shuddha gandhara*
vikrita Ga 6 (384 cents) or *Ga* 8 (384 cents)	,,	*sadharana or chyuta-madhyama gandhara*
shuddha Ma 9 (498 cents)	,,	*shuddha madhyama*
vikrita Pa 12 (618 cents) or *Pa* 10 (588 cents)	,,	*chyuta panchama madhyama*
shuddha Pa 13 (702 cents)	,,	*panchama*
shuddha Dha 16 (816 cents) or *Dha* 14 (792 cents)	,,	*shuddha dhaivata*
vikrita Dha 17 (906 cents) or *Ni* 19 (906 cents)	,,	*pancha shrutika dhaivata*

shuddha Ni 18 (996 cents) or *Kakali Ni* 20 (1020 cents)	,,	*shuddha nishada*
vikrita Ni 21 (1110 cents) or *Kaishika Ni* 19 (1086 cents)	,,	*chyutashadja nishada*

Here we find 1. a simplification: notes differing by 24 cents are theoretically traced to their source, but not given different names and treated musically as the same; and 2. new terminology for the *vikrita-swaras:* thus *chyutashadjanishada* shows it is a *Sa* flattened (by one *shruti*), which is in the range of *Ni; panchashruti Re* means a *Re* five *shrutis* above this *chyutashadjanishada.*

Thus we can say that in a way Ramamatya removed the extra complexity in names (not the structure) introduced by Sharangdeva and made the structure musically logical and more in accordance with Bharata's directives by taking 24 cents as a flexion and not as an interval, still, the musical system has not been affected.

We now come to Somnath (1600 A.D.), about a hundred years later and thus at least a thousand years, if not more, after Bharata.

Somnath is positive: "Previously they used to say there were twelve *vikritas,* in which those which have different (distinct) sounds are only seven and not five. *Achyuta Sa* and *Ma* are not different from *shuddha* — *Sa* and *Ma,* 4 *shrutis Re* and *Dha* are not different from *shuddha Re* and *Dha* nor is the *vikrita* 3 *shruti Pa* different from the 4 *shrut Pa.*"

The stand Somnath takes is similar to that of Ramamatya, but it will be noticed that he equals 4 *shruti Re* with *Re* 3, 4 *shruti Dha* with *Dha* 16, and 3 *shruti Pa* with *Pa* 13. This is an obvious impossibility, and to reconcile it with musical fact one must assume that he counts four *shruti Re* as 21 + 4, four *shruti Dha* as 12 + 4, and 3 *shruti Pa* as 10 + 3. He must therefore take *Ni* 21, *Pa* 12 and *Ma* 10 (1110, 612 and 588 cents) among his notes. This is indeed the case: his names are: 1110 cents, *mridu Sa,* 612 cents, *mridu Pa* and 588 cents, *teevratama Ma.* By the same logic he has *mridu Ma* on the 8th *shruti* at 408 cents, and *teevratama Ga* on the 6th at 384 cents, *teevratama Dha* on the 17th at 906 cents and *teevratama Re* on the 4th at 204 cents. Thus in *teevratama* he raises the *shuddha* note by 1 *shruti* and in *mridu* he lowers a *shuddha* note by 1 *shruti.* Hence the complexity introduced by Sharangdeva in stating 24 cents as specified intervals, which Ramamatya tried to eliminate, is again introduced. Somnath gives the names *teevra, teevratara* etc. for the intermediate notes he gets. We need not list all these notes here. We only notice that the words *teevra* and *mridu* are now beginning to be used, and that the compass of the name for each note is getting larger.

Pundarika Vithala, a contemporary of Somnath, has a simpler list. He omits *teevratara* and *teevratama*, and for *mridu* he writes *laghu*. The *Ma* 10 (588) he calls *panchashruti Ma*, perhaps because it is 5 *shrutis* (294 cents) higher than *shuddha Ga* 5 (294 cents).

In a similar way we can analyse the notes, *shuddha* and *vikrita*, given by various other authors; we find that the *shuddha* notes of all these persons are the same and the main *vikrita* notes, on positions 4, 8, 12, 17 and 21 (204, 408, 612, 906 and 1110 cents) are also given by them, the only difference being that different authors give different names to these. For example, the note on position 12, *madhyamagrama panchama*, is variously called *vikrita panchama, chyuta panchama, kaishika panchama, chyutapanchama madhyama, varali madhyama* etc. The note on position 4 (204 cents) is called *teevra rishabha, vikrita rishabha, chatushruti rishabha, panchashruti rishabha.* The note on position 17 (906 cents) is called *vikrita dhaivata, pancha shruti dhaivata, chatu shruti dhaivata.* The note on position 21 was called *chyuta shadja, chyutashadja nishada*, or *kaishiki nishada.* The note on position 8 was *chyuta madhyama, chyutamadhyama gandhara* or *antara gandhara.* This is the chronological order, which reveals a curious possibility.

Bharata's *antara gandhara* arose, as we have shown, out of a necessity to make that *Ga* 5 correspond with *Dha* 16, and thus *antara gandhara Ga* 7 was 318 cents, a comma higher than *Ga* 5 and thus a *komala swara.* The shift was 2 *shrutis*, 24 cents.

These later-day authors seem to have raised *Ga* 5 by 2 *shrutis* as stated by Bharata, but the measure of these two *shrutis* seems to have been taken as 90 + 90 = 180 cents, thus making *antara gandhara Ga* 7 = 294 + 180 = 474 cents, a comma flatter than the *shuddha Ma* 9, and thus even higher than our *teevra Ga.* The *antara gandhara* thus came to be regarded as a *teevra* note instead of a *komala* (in to-day's practice). Now Bharata had no *sadharana gandhara* as a specific note, it came to be so specific in Sarangadeva and it was, as we have shown, *Ga* 5 + 1 *shruti* = *Ga* 6 = 384 cents, a comma flatter than *teevra Ga*. What happened to this *teevra* note, the *sadharana gandhara* of old, when *antara gandhara* became a *teevra* note: its effect having been to raise *Ga* 3 *shrutis* from *Re* 3, these 3 *shrutis* being (*Re* 3, 114 cents 2 *shrutis*, 180 cents upto *Ga* 5 a further 1 *shruti* 90 cents; total 270 cents higher than *Re* 3); it is possible that this 3 *shruti* measure may have been taken as the usual 114 cents direct from *Re* 3: thus 114 cents + 114 cents = 228 cents, higher than *chatushrutika Re* 4 of 204 cents. In other words, the original *shuddha Ga* 5 (294 cents) was not shifted here and there, but 3 *shrutis* were taken upward from *Re* 3 direct, and 2 *shrutis* of 180 cents were taken upward from *Ga* 5 direct. Hence the old *sadharana gandhara*, a *teevra* note nearly equal to *teevra Ga*, now became a *teevra* note nearly equal to *teevra Re;* and the old *antara gandhara*, a *komala* note, became a *teevra-teevra gandhara*. The original sense of *swarasadharana* implying 24 cents shifts was lost and 180 cents shifts took its place.

The reason may be that when scales began to be described all together in steps on one string, the need for more than one *grama* no longer existed: it is the *madhyamagrama* (and perhaps also the *gandhara grama*) which enabled the location of *vikrita* notes in *shadjagrama*, but when *vikrita* notes themselves began to be specified as so many *shrutis* above or below a main note, there did not appear to be any need to refer to the *grams* as such, 24 cents were of course unavoidable, but they arose through 180 cents, or 114 cents shift, and not by themselves as such.

It was also realised that specification of many *shruti* positions in this manner was musically unfruitful. Hence some authors decided not to give separately the positions of so many *shruti* notes, but to concentrate on the main ones. Thus it was realised that *antara-gandhara*, which in its new sense had become a *teevra* note, had better be 'represented' by the main note *Ga* 8 (408 cents). This is the position accepted by Venkatamakhi (1600 A.D.). The total number of specific *shuddha* and *vikrita* notes thus remained at 12. Even Ahobala, who gave so many notes as *purva*, *komala*, *teevra*, *teevratara* and *teevratawa*, says towards the close of his book (1600 A.D.) that out of the list of fifteen *vikrita* notes he does not employ ten in music.

Ahobala and Venkatamakhi have tried to specify their notes by string-lengths. We have every justification to assume that an error of + or — 1/5th of an inch is quite possible in such specification. The lengths are given as so much portion of so much portion, which introduces a further indeterminancy, for all ratios within an octave, of whatever temperament, cannot be described by simple parts (thus for example, 16/15). Even so, such notes come surprisingly close to the ones we have calculated. There has been a lot of disscusion about Ahobala's *shuddha Re*, for example, and it has been asserted that his *shuddha Re* was on 204 cents. The original wording, after saying that *shuddha Pa* is 1/3 of the length from the nut (*meru*), says, "*Re* is to be placed in the first portion *Sa* and *Pa*". If the string length is 36," *Pa* is 12", from the nut. This 12" section divided into three, gives the first portion as 4". The middle of 4" is 2" from the nut, giving a vibrating length of 36" — 2" = 34". The corresponding ratio is 36/34 = 18/17, = 99 cents. The allowable error of + or — 1/5" gives a range of 1·8" to 2·2" from the nut; and we know that 1·83" will give 256/243 (90 cents), 1·87" will give 16/15 (92 cents), 2·25" will give 16/15 (112 cents), and 2·29" will give 114 cents. Ahobala's position for *Re* can therefore be said to be between 90 and 114 cents, greater accuracy is not justified; but in any case there is no need to insist that Ahobala's *Re* was 204 cents, i.e. on a point 4" from the nut. This 4" is the end of the first portion and the beginning of the second portion, and the wording just says 'in the first portion'. Why be dogmatic and insist on 4"? The reason must be an obsession with the word *shuddha* as meaning the modern *teevra*.

Ramamatya has described frets on his *vina*, whose open strings are tuned to *Sa* 0, *Ma* 9 and *Pa* 13. On checking with this description again the above analysis tallies.

						Optional		
Strings/Frets.		2	3	4	5	5A	6	7
Sa 0	*Re* 3	*Ga* 5	*Ga* 6	*Ga* 8	*Ma* 9	*Ma* 10	*Ma* 12	*Pa* 13
Pa 13	*Dha* 16	*Ni* 18 *Kai*	*Ni* 19	*Ch. Sa* 21	*Sa* 22	*Re* 1	*Re* 3	"*Ga* 4"
Ma 9	*Ch. Pa* 12	★	★	*Dha* 16	*Ni* 18	*Ni* 19 *Kai*	*Ch. Sa* 21	*Sa* 22

★ This fret is not to be sounded.

A detailed analysis of each book is not possible here, but the above will amply indicate the general thesis. It is as follows:

1. Right upto 1700 A.D., the *shuddha swaras* were the same. These correspond to our present day *komala* (except for *Sa* and *Pa*). At no time did *shuddha* mean our present *teevra*.

2. The main *vikrita* positions remained the same, but the way of describing them changed round about 1400. We refer to the *shruti* positions 4, 8, 12, 17 and 21.
   In Bharata's time they were obtainable by *murchchanas*. When the *gandhara grama* was considered, these *vikritas* cropped up. When more than one *grama* was not used, these *vikritas* were described only by flattening of one *shruti* of the *shuddha* notes, 5, 9, 13, 18 and 22.
3. The other *vikritas*, though many in Bharata's time were specifically only two: *antara gandhara* and *kakali nishada*. They were obtained by 24 cents' shifts necessitated by correspondence of the two *gramas*. A *Re* 1 and *Dha* 14 was also described without name. It was laid down that this 24 cents—2 *shruti-shift* can be made throughout the Octave to get 204 cents' intervals (4 *shrutis*) as various steps.

Sharangdeva performed this operation over the whole Octave, and, obtaining 12 *vikritas*, gave them various names: *chyuta, vikrita, antara, kakali, sadharana* and *kaishika*. The *chyuta, sadharana* and *kaishika* came in as new terms for notes.

Round about 1400 A.D., objections to Sharangdeva's numeration were raised on the basis that notes, in order to be properly called *vikrita*, must sound different; also that the open-string note being invariable, its note should not have two names. The tendency thus arose to regard *chyuta shadja* as a variety of *Ni*, and so on; also to reduce the number of specified main *vikrita* notes. 5 main *vikritas* were thus finally recognized. The others did exist but only as occasional notes. This outlook had the following effects:

1. *Sa*, and *Pa* came to stay as fixed *shuddhas* in *shadjagrama* and *Sa* and *Ma* as fixed for *madhyamagrama*.

2. Notes begin to be described as *vikrita* by their *shruti* intervals from *shuddha* notes alone, thus more than one *grama* was not necessary.
3. As a consequence, the original 24-cent temperament was replaced by 180 cents' temperament.
4. *Antara gandhara,* a *komala swara* in Bharata's time became a *teevra,* and *kakali nishada* also a *teevra.* It was also proposed to amalgamate these with the nearest *teevras* on positions 8 and 21.
5. The various *vikritas* were given various names by various authors, and the words *teevra, teevratar, mridu, komala, purva, panchashruti, shatshruti,* came to be coined. But the main structure remained the same. The only result was a confusion of terminology, so that one has to be very careful in reading any particular author and ensure that one sticks to that particular author's terminology only in so far as that author is under consideration. This did not effect the *shuddha* notes.
6. Hence we draw the conclusion that no cleavage ever occurred in the terminology and scale structure of North and South India. (The confusion exists only in the minds of our theorists).
7. What then about the Muslim invasion? It came about 1300 A.D. i.e. after Sharangdeo and before Kallinath's commentary thereon. Sultan Hussain Sharki had introduced the *Khayal,* and the various *Nayaks* like Bakshu, Dhondu and Bhagwan under Raja Mansingh were following the new *Dhrupadas,* just before Ramamatya. Tansen's time corresponds with Damodar, Pundarika Vitthal, Ahobala, Somnath, Venkatamukhi etc. Then came Jehangir's and Shahjehan's reigns. (It was only in Aurangzeb's time, the time of Bhava Bhatta, that in Delhi music was looked upon with disfavour. Soon after Gulam Rasul, Miya Shouri, Sadaranga, Adaranga etc. rose up with the new *Khayal* and *Tappa.*) How is it that despite these political upheavals we find no major revolution in our scale structure?

The only logical answer is, the Muslim invasion did not touch the structure. Muslims may have imported the new way of looking at the scale and thus influenced the withdrawal from the two (or 3) *gramas* and the *swarasadhana* system. The method of specifying *shuddha* and *vikrita* notes as degrees of only one octave may have been due to Muslims. They may have brought in new styles of singing and playing, new embellishments in melody. But the scale system basically was left unchanged, whether in the North or in the South. And the Muslims may have brought in the custom of singing to the drone of the *tambura*, thus putting into the back ground the *murchchana* system, and making *Sa* and *Pa* invariable notes. As a consequence it is possible that since the *tambura* drone is partial to *Sa* 0, *Pa* 13, *Re* 4, *Ga* 8, *Ni* 21, the *teevra swaras* came more into prominence, so that the basic scale may have come to be regarded not as that of *Bhairavi* but as that of *Kalyana* or of *Bilawal*. (This means that the order of *murchchanas* changed: the basic scale instead of : *Sa* 1, *Re* 4, *Ga* 4, *Ma*9/4, *Pa*13/1, *Dha*14/4, *Ni*18/4, *Sa*22 was regarded as *Sa*0/4, *Re*4/4, *Ga*8/4, *Ma* 12/1, *Pa*13/4, *Dha*17/4, *Ni*21/1, *Sa*22 or as *Sa*0/4, *Re*4/4, *Ga*8/1, *Ma* 9/4, *Pa*13/4, *Dha*17/4, *Ni*21/1, *Sa*22.

8. If there was a change in the basic scale as suggested above, an extra confusion is likely to have been introduced in the *raga* descriptions of latter-day authors, especially after 1500 A.D. and these authors must be read with closer attention to terminology when they mention, not *shuddha* but *vikrita* notes under various names.

It is this confusion that comes in the way of our tallying the notes given by latter-day authors for the various *ragas* with our present-day notes. Proper interpretation of terminology is called for in this case, not an assumption that everything has turned topsy-turvy. It is highly improbable that the *graha-ansha-alapa* system remained, the names of the *ragas* also remained as of old, but the *ragas* themselves changed!

That the names of *ragas* are different in South India may be attributed to differences in dialect; because the proportion of *ragas* of one name being sung differently in the two regions of India is low compared to the names themselves being different.

The substance of the thesis therefore is that the tradition of Indian music is continuous and unbroken: an evolution being of course inevitable.

This thesis runs contrary to the prevailing 'theory' that the Muslim invasion about 1300 A.D. brought a major upheaval in music itself; that the old terminology, scale structure, *raga* systems, all underwent a change in North India while the South remained true to old tradition; that the North Indian authors after 1400 A.D. do not tally with South Indian authors, that many of them do not know what they are writing, that the old *shuddha* now means *teevra,* and so on. This 'theory' and its presentation does not stand the test of logical reason as Kapileshwari's thesis does. He first fixes the old system and makes deductions, whereas others start with preconceived notions and adjust facts tc suit their hypothesis.

We conclude: To-day's music has a direct link with the past. We have only to bear in mind that the art form has developed by evolution. The basis is unchanged.

The Raga System

The present-day *ragas* are therefore descendents of the old *jatis* and *prabandhas.*

A *raga* has ten essential characteristics: — *graha,* the starting note; 2. *ansha,* the main note; 3. *nyasa,* the concluding note (also *apanyasa* and *vinyasa,* the notes on which phrases end); 4. *alpatva,* the smallness of 'value' (in terms of *laya* or duration) of certain notes; 5. *bahutva,* the largeness of value of certain notes; 6. *ouduvatva,* whether the *raga* takes only 5 notes; 7. *shadavatra,* where it takes 6 notes. 8. *tara,* how far the notes rise in the upper register; 9. *mandra,* how far the notes go into the lower register; 10. *murchchana,* which fixes the sharpness or flatness of the notes.

Now, we have no factual data to show how the *jatis, prabandhas* etc. were sung or played in the old days. The latter day books describe *ragas* only by their scales and by giving their *graha, ansha* and *nyasa;* the detailed melodic progressions are unknown. We can only examine to-day's progressions and see how far the above characteristics are followed:

The *murchchana* fixes the *komal-teevra swaras.* We have however given up the *murchchana* system. Furthermore, in our present-day music we have many *ragas* like *Bhairava, Khat, Todi, Patamanjari, Pilu, Marwa, Puria, Puriadhanasri, Darbari, Paraj* etc., which do not fit in the seven main *murchchanas* because of their notes not forming intervals of 1-4 *shruti* steps, or because they have other auxiliary notes, or because their ascents and descents are not uniform. We therefore have to specify the notes of our *ragas*, not the *murchchanas.* We have to state their *shruti* values (e.g. the *Re* of *Bhairava* as against the *Re* of *Bhairavi* etc.), and the order in which the notes have to follow each other in the skeleton scale (e.g. *Sa — Ma — Ga — Pa* or *Sa — Ga — Ma — Pa in Bihag* and *Tilang, Sa —Ga — Re — Sa* — and *Sa — Re — Ga* in *Kafi* and *Bhimpalasi* etc.).

The *tara mandra* rule is also followed strictly. No one sings *Darbari* going high up in the treble octave, and to sing *Basant* in the bass side only would be ridiculous.

The *ouduvatva — shadavatava* rule is also followed. Take for example *Bhupali, Malkos, Malashri* or *Durga.* The notes are prescribed, but we go by smooth transition from note to note—our music is not pure melody of single notes standing by themselves. In our melodic progression we have to glide over intermediate notes which do not belong to the *raga*, and we arrange the glide in such a manner that in *Bhupali* there is no trace of a *komala* note or in *Malkos* there is no trace of a *teevra swara.* Furthermore, we seldom take 4 *shruti* successions, because in *ouduva* and *shadava ragas* 5 and 8 *shruti* intervals are bound to arise. We show these 5 and 8 *shruti* intervals, as well as 9 and 13 *shrutis*, i.e. we follow the *samvadi* rules. For example in *Durga, Sa —Ma — Re— Pa, Dha—Ma—Pa,* is regarded as far better representing the *raga* than straight *Sa — Re — Ma — Pa.* In the former case the *shruti* steps are 9—5 9; 4 — 8 — 4; in the latter case they are 4 — 5 — 4.

As regards *graha-ansha* and *nyasa,* we find that in a *raga* there is such a triad. The intervals between them are any three out of 13, 9, 8 and 5. If one of these is the *ansha* (some call it *vadi*), the *graha* and *ansha* are 13, 8, 8 or 5 *shrutis* above or below it. The choice is governed by the tune, the words in song, and the tempo. There is not just one specific *ansha* (*vadi*) for one *raga:* a *raga* can have any one of three notes as *ansha*, and the remaining two are the *graha* and *nyasa*.

Alpatva and *Bahutva*, called *swaralaya*, are the essence of our melodic progression. In *Bhupali*, if each note is of 1 time unit (*matra*), the ascent lengthens the *Ga* to 2 units, the *Pa* to 2 units; but in descent the *Dha* is 2 units, and *Pa* only 1 unit. If the *Pa* is lengthened to 2 units (*bahutva*) in descent the *Bhupali* will degenerate into *Deskar*. A better illustration will be found in determining the *alpatva* and *bahutva* of the *Dha*, *Re* and *Ga* of *Bhairavi* and *Bilaskhani*. Had this *alpatva* and *bahutva* not been there, there would be very little indeed left to distinguish *Bhairavi* from *Bilaskhani*. *Khamaj* and *Tilang* and *Zinjoti* would provide another instance. It is not merely what notes are taken in a *raga* that characterise it; — we even take a *teevra Ni* in *Kafi* and it sounds good — nor the order in which they are taken—we sometimes do proceed *Sa* — *Re* — *Ga* — *Ma* in *Bhimpalas* — but the main thing is, how much relative time, large or small, do we give to the various notes; i.e. what is the 'value' of each note. If the various values are not observed the *raga* fails. This '*swaralaya*' is the crux of melodic progressions.

All this can be easily proved by analysing the musical phrases of past masters.

The dynamics of our music thus rests on two main pillars: the *samvadi* rule of 13, 9, 5 and 8 *shrutis*, and the *swaralaya* principle. When the *samvadi* rule is not observed we get a mere skeleton and when the proper *swaralaya* is not observed we get a caricature of music.

The present-day 'systems' of music prevalent in our schools specify: (1) The '*that*' of a *raga*, i.e. its pigeonhole in a classification-system of notes according to *teevra* and *komala*; (2) the *vadi* and *samvadi*, i.e. the note used most often, and the note used next often; (3) *anga*, i.e. whether the upper four notes prevail or the lower-four, (4) *chalan* i.e. the order of the notes, (5) the time of the day at which the *raga* is sung. Then follow exercises on scales which form the *alapa* and *taans* in actual singing afterwards.

All this is merely a partial view. We shall not go into the merits or otherwise of the that system, but knowing to which particular pigeonhole a *raga* belongs gives no idea of the fine *shruti* intervals; the *Re* of *Bhairavi* and of *Bhairava* have to be discriminated. Merely saying the two are 'different' does not help saying the one is fixed and the other a vibrato (*andolita*) is far from correct, and saying one takes a 'grace note' shows that the meaning of 'grace notes' is being distorted. Second point: It can be shown that the rule "one *raga*, one *vadi*" is not correct. Third point: besides the *anga*, the *mandra-tara* range has to be specified. Fourth-point: *Chalana* must not mean acrobatical ups and downs. The *swaralaya* and *samvadi* rule must be specifically shown.

In the absence of the observation of the proper principles of *raga* singing, embellishments of *meend, ghasit, khatka, kampa, murki* etc. are neglected, and these form the main attraction of our music. All that remains is acrobatics on the ladder of fixed notes, up and down. This is not music.

The time of the day is given in the old books, but it is a moot point whether in the modern context it can or need be observed. A melancholy *raga* suits a melancholy mood, and such a mood need not necessarily exist in the evenings in the month of *Shravana* if one lives in a city like Bombay or Delhi.

The place of rhythm in our music is not properly presented in our prevalent 'systems'. Rhythm must form an integral inseparable part of the melodic progression, and the beat must not encroach upon the sentiment. What do we find instead? While the acrobatics are going on, rhythm hardly matters and when the jugglery of trills is over, rhythm takes over and bursts into the music. Words are distorted and sung to the fractional parts of the rhythmic beat, so that not only the meaning but even pronunciation is reduced to a mockery. Only that music can appeal in which words, meaning, notes, their consonances and musical melodic progression, the *swaralaya* and *tal* (rhythm), all go hand in hand to make an integral whole. Our prevalent systems completely ignore this fundamental fact.

Much depends upon words: Spanish and Italian vocal music is more melodious than English or German because of the predominance of vowels. Similarly the *alapa* of South Indian Music is different in texture because of the predominance of consonants in the Southern dialects. Hindi (Vraj and its varieties) are adaptable to the *alapa* of North Indian music more than other dialects because of the predominance of the vowels and their adaptability (thus: *pi*, *piya*, *piyarawa* etc.).

Our Notation System

It is supposed that notation is something new in this country. This is not correct. In singing, the *tarana* and *chaturanga* form sung by most musicians, includes pronunciation of the notes among other things; and at least two traditions of hereditary musicians, the *Kirana* (represented by Bande Ali, Abdul Karim Khan, Haidar Bux etc.) and the *Muradabadi*, wrongly called '*Bhendi Bazar*' (represented by Nazir Khan, Chaju Khan, Khadim Hussain, Aman Ali etc.) actually teaches *alapa* by notation In South India singing notation is common. Older demonstrations are of course not available to-day for lack of recordings, but we have the old writings. Such books have the serial numbers of *shruti* notes written on top of letters, and in as old a book as that of Sharangdeva we find a detailed description of a written notation system.

It is important to note that this old notation of Sharangdeva attaches great value to the duration of each note: he describes various signs to indicate multiples of a time-unit (*matra*) and fractions thereof. These fractions are on the system of even division (*laghu-guna*) or uneven division (*pluta*).

The latter day writers however seem to have concentrated more on giving short descriptions of a huge number of *ragas* under some pigeon-hole system or another; such descriptions do not help us in finding out how a given *raga* was actually sung or played with its various note-values (durations), the pauses (*virama*) which are very important for the art of music, the embellishments and so on. These descriptions therefore can at the most serve as a dictionary and not as sources of musical score.

After 1800 A.D. the question of notation again came up with the spread of printed literature. The first writings were those of curious, sympathetic and research-minded scholars like Sir William Jones, Capt. Day, Mr. Willard, Mr. Fox Strangeways, Mr. Popley and so on.

They of course used the staff notation. This practice was followed by Surendramohan Thakur.

The chief merit of the staff notation is that it directly gives duration of note-values as an integral part. It is also a visual chart. However, the notes represented by the staff notation have to be suitably re-marked to fit our *shruti* system or *komala-teevra* system. For example C sharp is 3 *shrutis* and D flat is 1 *shruti* (very nearly). We have also to use double-sharps and double-flats. Further, for our *teevra Ga* on the 8th *shruti* we have to use, not E, nor F flat, but a special sign, for our *teevra Ga* is only a comma higher than E whereas F will be nearly the just E of 384—386 cents which is our old *sadharana Ga*-6. Again the melodic progression by embellishments needs further special notes; and special bars and signs become necessary to indicate the various parts and stresses of the rhythm such as *jati, khanda, anga, sama, khali* etc. All this can of course be done; but the result is a new complex system which our musicians do not relish because there are too many things to relearn, because they play or sing by ear and not sight, and because the connection of the signs with the *Sol-fa* (*sa-re-ga-ma*) no longer exists. Hence the staff notation was judged unsuitable for Indian music.

Pt. Vishnu Digambar revived the staff idea but in doing so he neglected the essential merits of it. These, for Indian music, are two: the staff notation would enable by modulation, a revival of the *murchchana* idea and this might give new ideas in the development of *ragas*; and the staff notation would impress upon everybody the essential fact that *swaralaya* is an integral part of melody. Vishnu Digambar separated the note-values, gave them special signs modified from Sarangdeva, and wrote these note-values below the staff. Though this was done in order to accommodate the *tala* (rhythm) complexities and the *swaralaya*, the integration was lost. Pt. Vishnu Digambar's staff therefore had no special merit and he himself gave it up.

Pt. Bhatkhande adopted the sol-fa system as such, and made the notation a simple affair. Signs were provided for the three registers and the *komala-teevra* modifications, and bars to indicate the parts of a rhythm and the stresses (*khanda, sama, tali and khali*). But no provision was made for note-values (*swaralaya*), so the system became a skeletal structure only. *Meenda, khataka, murki, ghasit,* upper or lower *shruti*-touches (which are not *kanas* or grace-notes but minute touches with glides) were not provided for and in any case their values were indeterminate within the tune-unit. It became possible for two persons to read the same notation with different intonation. This skeletalisation, along with confused terminology (today's *teevra* = old *shuddha, shuddha* also means *teevra,* but *shuddha Ma* is not *teevra* but *komala, teevra madhyama* is higher than *shuddha madhyama* but *teevra gandhara* is not higher than *shuddha gandhara* because the two are the same), came in the way of anything like a correct record of melodic forms. (The music based on a teaching on such basis is certain to be imperfect but because powerful agencies like the AIR have given preference to this system and have based their judgements and tests on such systems this music has gained popularity and Gresham's law has operated to the detriment of good music).

Abdul Karim Khan initially started with signs for note-values to indicate *swaralaya,* but later on decided, in the interests of simplicity, to write the values below the notes by means of actual fractions such as 1/2, 1/4, 1/3, 1/5, 1/8, 4/4, 7/8 etc. He also did away with the confusion created by the *komala-shuddha-teevra* problem by dropping the name *shuddha* altogether and sticking to the *teevra-komala* classification, reserving the name *shuddha* only when referring to *komala* notes (except *Sa and Pa*) when they occur in old books. In other respects, he decided to follow Bhatkhande's ideas for three reasons: their simplicity, and their wide acceptance, and because he wished uniformity in the country.

Kapileshwari's stand, therefore as based on Abdul Karim's precepts, is that in any notation system the sol-fa must exist, the notes must be specified not only as *komala* and *teevra* but as such and such a grade of *komala* or *teevra,* by specifying *shruti*-intervals or *shruti*-positions, signs must be provided for the embellishments of upper and lower *shruti*-touch, upper and lower *kana, meenda, ghasit, murki, fanda, zamzama, gamak,* etc., and above all, the *swaralaya* must be distinctly shown as an inseparable part of the *swara* — the *ga-re-sa* of *Shankara* and of *Yaman* must be capable of being distinguished from one another; this is an affair apart from the rhythm or *tala* as such, and for the *tala* itself, means have to be provided to denote the *khanda* and *anga,* the bars, the *sama,* the *tali* and the *khali.* The closer approach to this ideal the better the notation, but *swara-laya* is a basic requirement in any case, failing which we shall have nothing but skeletons which can be interpreted in any way we like. Even short and long pauses must be marked with the durations allotted to them.

And above all the confusion the *shuddha Ma* as the *Sa* as *komala Ma* but *shuddha Re, Ga, Dha, Ni* the same as *teevra Re, Ga, Dha, Ni, teevra Ma* being a note higher than *shuddha Ma,* must be eliminated. The most logical way is to propose that —

(1) the *Sa* and *Pa* are to-day invariable on the 0 and 13th *shrutis;*

(2) the old *shuddha Re, Ga, Ma, Dha, Ni* are to-days *komala* (not *teevra*) notes as found in *Bhairavi,* on *shrutis* 1, 5, 9, 14 and 18;

(3) Old *chyutapanchama* is to-day' s*teevra Ma,* and similarly to-day's *teevra Re, Ga, Ma, Dha, Ni* as found in *Kalyana* on positions 4, 8, 12, 17, 21, are the old *chyuta Ga, Ma, Pa, Ni, Sa;*

(4) We should not therefore use the word *shuddha* in the context of to-day's scales;

(5) Where certain *ragas* like *Bhairava, Todi,* etc., necessitate other notes such as *Re* 3, *Ga* 7, *Ga* 6, *Ni* 20, *Ni* 19, *Dha* 16 etc. the *shruti*-intervals of these notes should be specified. Thus *Bhairava* takes *shrutis* 0, 3, 8, 9; 13, 16, 21, 22 with intervals 3, 5, 1, 4, 3, 5, 1 and so on. These points have been elaborated and demonstrated in Kapileshwari's book *Shrutidarshan* in Marathi.

The above system has been actually tested in the educational schools, run on the person-to-person (Gurukul) basis started by Abdul Karim Khan and being run till now, over a period of 55 years.

To Sum Up

This research work establishes the laws on which our ancient scale system was based, in terms of modern terminology; and incidentally also establishes what were the three *gramas* and what useful purpose they served. It also develops the *grama* system on which singing and playing of the ancient *jatis* and *prabandhas* were based.

It establishes that the theoretical basis of scale building has remained unaltered till to-day, that there has been no major unheaval because of Muslim invasion and domination; that the basis of South Indian Music is the same as that of the rest of India.

It connects the modern notes with the ancient notes.

It establishes the laws of melodic composition and melodic progression in our country, on which the *jati-prabandha-raga* system is based.

It describes the characteristic essentials of a *raga* and shows that these are essentially the same as those laid down in the olden days. It stresses the basic inseparability of tone progression with note-values (duration or *laya*).

All this is supported by observation, experiment, demonstration, musical theory, the laws of physical and physiological accoustics, and the ancient texts.

It indicates what an ideal notation system should be like for our music, and what should serve as the guide-lines for the teaching and exposition of real classical music.

Incidentally, in doing so, it does away with the presumption that 'classical' music is something apart from our daily sphere: all Indian music obeys the same basic laws; all Indian music is strictly melodious, and there is no reason for it to fall from grace.